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REPORT

Living Building Challenge™

CODE, REGULATORY AND SYSTEMIC BARRIERS AFFECTING LIVING BUILDING PROJECTS

Cascadia Region Green Building Council

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TABLE OF CONTENTS

MODULE 1

EXECUTIVE SUMMARY 1

INTRODUCTION 7

OVERVIEW OF THE LIVING BUILDING CHALLENGE 9

MODULE 2

A LARGER CONTEXT FOR RISK AND RESPONSIBILITY: CODE, REGULATORY & RELATED SYSTEMIC BARRIERS TO LIVING BUILDING PROJECTS 15

MODULE 3

ANALYSIS OF THE BARRIERS TO THE LIVING BUILDING CHALLENGE 35

MODULE 4

RECOMMENDATIONS & CONCLUSIONS 59

MODULE 5

ACKNOWLEDGMENTS 77

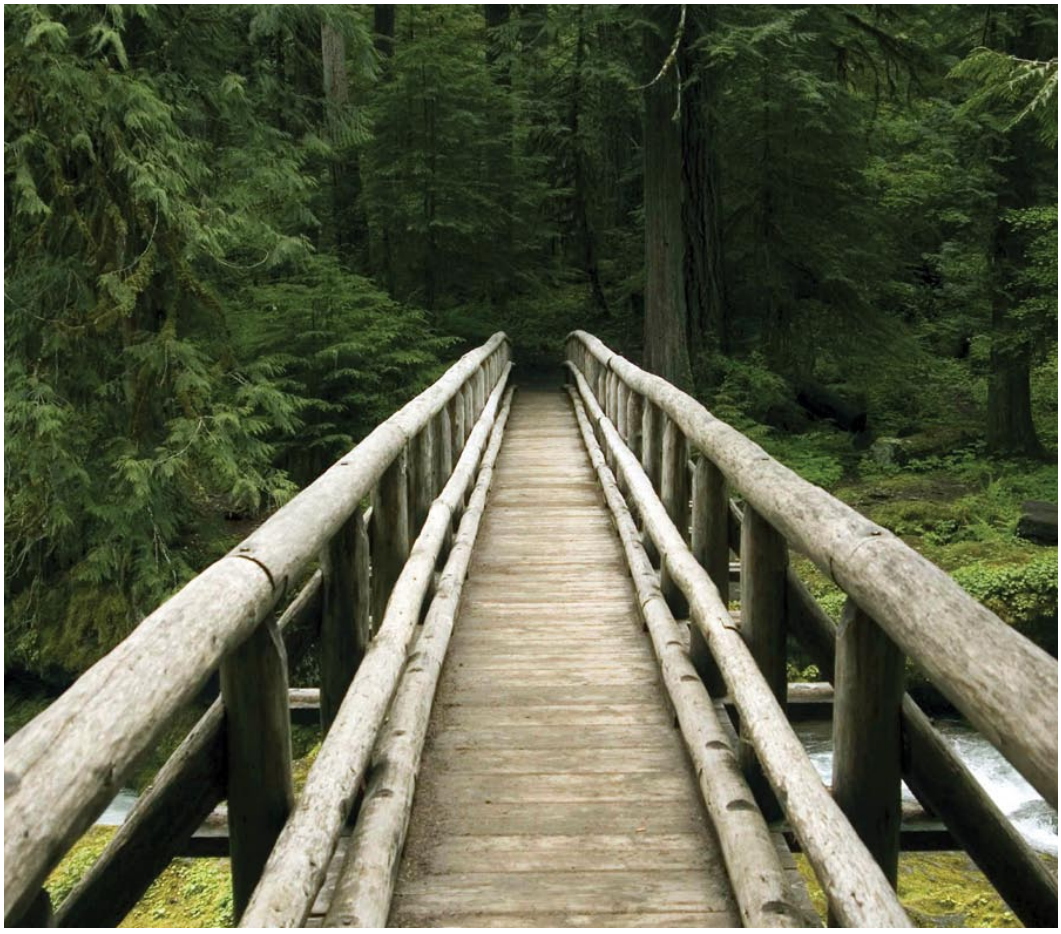
RESOURCES 80

REFERENCES 84

MODULE 1

EXECUTIVE SUMMARY
INTRODUCTION
OVERVIEW OF THE LIVING BUILDING CHALLENGE™

There is an awakening to the reality that long-held assumptions on which much current regulatory thinking is based are no longer valid.



EXECUTIVE SUMMARY

The development of the Cascadia Region Green Building Council's Living Building Challenge marked the onset of the next stage in understanding the relationships between built projects and the natural and human systems in which they are embedded. The Living Building Challenge establishes benchmarks for project teams seeking to move beyond current green building standards, such as the LEED® Rating Systems, into a performance-based, post-occupancy evaluation of a project's efforts to maximize efficiency and sustainability. The Living Building Challenge sets substantially higher performance requirements across a more comprehensive set of criteria than required by regulation, or any rating system currently in use. Projects striving to meet these criteria need to employ innovative strategies and systems. The result is often much greater difficulty navigating the maze of regulatory approvals than projects seeking only to meet minimum regulatory requirements. This report is an initial exploration of the broader set of barriers, their origins, and strategies to overcome them.

Cascadia, a chapter of both the U.S. Green Building Council and the Canada Green Building Council, includes Alaska, British Columbia, Washington and Oregon. However, the Living Building Challenge framework is applicable to all states and provinces, not only the Cascadia region. Currently, Living Building projects are in design or under construction across North America, as well as internationally.

This report addresses both systemic and specific regulatory barriers encountered by projects pursuing the goals and prerequisites established by the Living Building Challenge within the U.S. and Canada. The methodology employed in developing it included examining the range of

regulatory and other approvals required to design and build leading-edge projects, surveying Living Building Challenge project teams, researching and reviewing existing literature on this topic, and interviewing knowledgeable experts across the U.S. and Canada in the public and private sectors, in research, and in non-governmental organizations.

A paradigm shift is underway in how buildings and developments are designed and built. Key findings from this research point to the need for a parallel shift in how they are regulated. There is an awakening to the reality that long held assumptions on which much current regulatory thinking is based are no longer valid. These assumptions include that we will continue to have adequate supplies of affordable energy, fresh water and other key resources, a stable and predictable climate, and that the natural systems on the planet are robust enough to withstand the growing level of human impact. Increasing evidence of these emerging risks obligates us to take action.

The impacts of building and development contribute substantially to these crises, arising throughout the lifecycle of built projects. They begin far from the building site and long before the building exists, and they extend far beyond the site and the life of the building. They emerge during the acquisition of resources and their transportation and processing. They come from impacts on the land and natural systems at the site, and related impacts from the infrastructure projects typically require. They involve impacts during construction and throughout the life of a building to maintain, repair, heat, cool, ventilate, illuminate, remodel, and eventually dismantle and dispose of, or recycle and reuse parts of it. Only a small fraction of those impacts are regulated.

A crucial misconception at the heart of many apparent obstacles for Living Building projects is that proponents of sustainable development have different goals or agendas than the regulators. In truth, the goals of both groups are aligned – no one wants unsafe projects. A key finding for moving towards more fruitful interactions is seeing that what is deemed "safe" in regulatory terms, depends entirely on which risks will be considered and which will not. Historically, concerns about risks like climate change, resource depletion, ecological health, or persistent toxic chemicals have not been included in building and development codes and related regulations. Much of the current resistance to addressing these larger risks is based on the belief that current building and regulatory practices adequately safeguard the public. To people who take these larger risks seriously, there appears to be a false sense of security founded on too narrow an assessment of risk. Recognizing that Living Building projects voluntarily address a more comprehensive set of risks than currently required by regulation helps dispel a persistent perception that these projects are trying to get away with something that is 'less-than-code'.

Proponents of the Living Building Challenge do not claim that new and innovative strategies or systems designed to meet the prerequisites of the Challenge are risk-free. Nor do they expect that projects pursuing Living Building status should be exempt from meeting the intent of current regulations. However, the reality that such projects so often experience regulatory challenges is the best indication of problems in the regulatory realm. A good measure of progress will be when projects contributing the most to large-scale environmental crises have as difficult a time navigating through the regulatory system as those projects that contribute the most to the solutions do today.

Significant shifts are already underway. Green building projects are becoming commonplace in many communities, and numerous systems and methods that were considered "alternative" a few years ago are being incorporated into codes and standards. At the same time, significant obstacles persist and the need for change grows more urgent. A rapid transition is now needed towards a more deeply integrated and comprehensive regulatory system. Creating such a system will be challenging, but likely nowhere near as challenging as what will await us if we choose inaction instead.

Although this is a time of great financial stress for government agencies, there is an enormous opportunity to use some of the U.S. federal green stimulus funds for both green building and infrastructure projects, and to support greening the regulatory systems in advance of them to ensure they meet their goals. Regulatory agencies everywhere are challenged to find the resources needed to make the changes that will be demanded of them. By investing in staffing, training, and upgrading codes and standards, the green projects in the pipeline will have a better chance of maintaining their sustainability goals throughout the regulatory processes.

Such large-scale change calls for unprecedented collaboration and cooperation among regulatory bodies and all other stakeholders. While the combination of challenges makes a regulatory paradigm shift seem implausible, what is at stake might also spark a marshalling of resources akin to the response to President John F. Kennedy's 1961 challenge to the U.S. to put a man on the moon in a decade. The national effort behind the Apollo Project enabled that goal to be achieved in eight years. Today we face a much bigger challenge – supporting billions of healthy, productive people on planet Earth in the coming decades without jeopardizing the well-being of all future generations. There are few more worthy endeavors.

SUMMARY OF RECOMMENDATIONS

This report provides a framework of recommendations to inspire immediate action. A complete list of recommendations for addressing barriers to the Living Building Challenge and projects seeking similar goals is located in the Recommendations and Conclusions section at the end of this report. The following summary of the recommendations is broadly organized, beginning with those that can likely be implemented in the short term in order to support the goals of the Living Building Challenge, to strategies for addressing systemic barriers that will require larger and longer-term processes.

1) IDENTIFY AND ADDRESS REGULATORY IMPEDIMENTS TO GREEN BUILDING AND DEVELOPMENT

Regulatory impediments and suggested changes that are discussed in depth can be found in the energy, water and materials/waste realms. Site considerations are also included throughout the recommendations:

- Provide regulatory support for energy and water conservation and demand management.
- Remove regulatory barriers to cascading uses of energy and water.
- Address the imbalance of historical support for centralized utility systems over distributed systems by means of regulatory and fiscal measures. For example, renewable energy should be given priority access to the grid over non-renewables; new code provisions and permit guidance should be provided for all active onsite renewable power generation; solar access should be balanced with provisions for shade benefits; and hurdle rates should be mitigated for energy efficiency measures and renewables. In the water realm, protocols and systems should be developed for third-party monitoring, operations, and maintenance service delivery for on-site water supply and treatment; and regulatory provisions that restrict onsite rainwater harvesting should be updated to encourage this practice where appropriate.
- Eliminate zoning and utility regulatory barriers to viable site and district renewable energy and water system opportunities in relation to centralized alternatives.
- Align energy codes using goals of the Architecture 2030 Challenge and the 2030 Challenge Interim Code Equivalents.
- Facilitate energy performance benchmarking, third-party performance evaluations and the ratcheting up of building and appliance performance standards. Institute performance audits upon sale or major renovation.

- Facilitate regulatory mandates in the insurance, finance and investment sectors to require all companies responsible for portfolios to act on climate change issues in their own operations and in their portfolios.
- Focus on resolving staffing and other challenges to regulatory enforcement.
- Develop inter- and intra-jurisdictional policies that support waste management revenue streams appropriate to sustainability goals.
- Ensure appropriate guidance is available for materials, particularly for those in widespread or prescriptive use that are subject to operational risk.
- Update building and energy codes and valuation systems in relation to natural building materials. Provide regulatory guidance on natural building materials, low-energy, and passive systems.
- Develop closed-loop waste management systems to enable appropriate reuse of materials, local materials supply in a low-carbon environment, and local economic development.
- Adopt The Natural Step and/or the Precautionary Principle for guidance in government decision-making, and in building rating systems.
- Reassess the basis for the regulatory requirements in terms of what they protect and whether the public interest is served when viable opportunities to optimize crucial resources are constrained by regulations, independent of their safety or efficacy.

2) CREATE INCENTIVES MATCHED WITH DESIRED GOALS

Facilitate the creation of comprehensive green development incentives in the building, planning and related sectors to encourage sustainability goals:

- Decouple energy and water utility revenues from sales so revenues do not increase with consumption. This will allow utilities to engage in conservation and demand management programs without an associated loss of income.
- Enable realistic pricing policies for energy production that include typically hidden costs to health, environment and the economy.
- Develop innovative energy efficiency and renewable energy financing systems (while encouraging local economic development), including 'Negawatt Plants,' feed-in-tariffs that incorporate energy storage, system benefit charges, local improvement charges, on-bill financing, tax incentives, renewable portfolio standards, technical assistance and renewable energy mitigation programs.
- Facilitate federal and state incentives to encourage passive measures in minimizing energy use.
- Use tenant incentives to mitigate plug loads such as retailer sales incentives for Energy Star labeled products.
- Address split incentives – such as by modifying practitioners' compensation to reward building performance.
- Employ developer incentives like fast-tracked permitting and reduced fees.
- Provide financial incentives to recognize and encourage inclusion of building and development measures with significant societal benefits, including improving public health, reduced consumption of natural resources, reduction of heat island effect, and avoidance of infrastructure supply, repair, and expansion costs.
- Develop Appraisal and Portfolio Valuation Financial Incentives and Systems that: ensure investments address climate change risk; facilitate links between green building measures, productivity, and appraised value; provide incentives for building evaluations to include life cycle analysis; require that appraisals include green measures such as energy efficiency; and include energy performance, greenhouse gas emissions, water use and green features in real estate listings categories.

3) DEVELOP EDUCATION & ADVOCACY PROGRAMS

- Develop curriculum and training for regulatory staff to facilitate both improved regulatory input and understanding of the integrated design process.
- Develop accessible, reliable, up-to-date, and appropriately evaluated information hubs to effectively share best practice solutions to regulatory issues.
- Create an expanding library of code compliance packages for alternatives, containing all relevant information needed by designers, builders, developers and those in regulatory roles.
- Develop the equivalent of the LEED Credit Information Request (CIRs) system for codes, to accelerate acceptance of alternative approaches through shared information about successful approval processes.
- Create an alliance of green building and code sector volunteers organized into standing committees to map out pragmatic, structured pathways to developing "alternative solutions" per the previous recommendation.
- Engage the U.S. Green Building Council and Canada Green Building Council to mobilize and encourage their members to become involved in codes and standards development processes at local and national levels.
- Create public committee structures to evaluate and support the approval process for alternative materials, methods and designs, like the Portland Alternative Technology Advisory Committee.
- Initiate continuing education credits for participation in regulatory processes, for professional practitioners.
- Enhance visibility of the benefits of public safety enforcement to encourage adequate funding for regulatory agencies.
- Use building and appliance labels to enable industry and public access to performance data.
- Provide insurers, appraisers and regulators with information about risks of conventional practices and the risk mitigation potential of sustainable strategies.

4) ACCELERATE RESEARCH, TESTING, DEVELOPMENT, DEPLOYMENT AND MONITORING

- Support research, testing and development of passive optimization strategies including passive solar and those that eliminate the need for materials, products and systems by design rather than the current near-exclusive focus on technology development.
- Provide support for testing protocols and systems to help address gaps in the availability of viable alternative building materials based on a paradigm shift that avoids materials with negative health or environmental profiles.

5) CREATE GREEN ZONES AND DESIGNATED SUSTAINABLE DEVELOPMENT DISTRICTS WITH HIGHER INTEGRATED PERFORMANCE CRITERIA AND REGULATORY AUTHORITY.

Facilitate 'green zones' – development zones or districts with both higher performance criteria and consolidated regulatory authority, or an agency within the jurisdiction having authority and the ability to intercede with all other regulatory agencies on behalf of the integrated goals of the zone or project.

6) FACILITATE THE CREATION OF AN INTEGRATED REGULATORY PROCESS AND A HOLISTIC, INTEGRATED REGULATORY SYSTEM

- Convene a national conference on Regulations, Sustainability and the Built Environment, including participation of the full spectrum of public interests in the built environment to begin a process of creating a holistic and comprehensive regulatory "system."
- Develop national policies and support for continuous and explicit representation in regulatory processes for human and ecosystem health, and for the welfare and rights of future generations
- Incorporate a formalized anticipatory and precautionary focus into regulatory processes.
- Adopt legal and regulatory systems that motivate and encourage positive outcomes (not merely prevention of negative ones).
- Encourage insurance and reinsurance regulators to require key corporate executives to be educated about climate, energy and other risk exposure related to their environmental performance as well as sector-specific best practices and strategies.
- Encourage regulators to require insurers, financial and investment advisors to recognize portfolio risks of unsustainable activity particularly with respect to climate change.
- Enable a comprehensive public process to articulate societal goals, assess the overall regulatory needs and relationships to support those goals, and then the design of a coherent regulatory system based on clearly articulated and agreed upon principles.
- Adopt legal and regulatory systems that recognize and account for cumulative environmental impacts and the limits of ecological systems.
- Develop a system for recognizing enhanced value of projects voluntarily internalizing as many of these risks and impacts as possible.

7) ENSURE SOCIAL EQUITY IN POLICIES THAT SAFEGUARD PUBLIC HEALTH, SAFETY, AND WELFARE

In light of the current environmental and economic crises, and the vital role that green buildings have to address these challenges, it is of growing importance that the regulatory realms ensure that everyone can participate in the benefits of the green building movement. The Apollo Alliance provides a good example for engaging all citizens and the opportunities to encourage social equity through greening buildings.

INTRODUCTION

In 2006 the Cascadia Region Green Building Council released the Living Building Challenge, a call to action for the design and building industry to achieve higher levels of sustainability in the built environment. At the time, few projects in the United States or in Canada were looking beyond the best practices of the green building movement towards true sustainability. In the last two years however, the interest in Living Buildings has grown exponentially, with more than 60 projects across the U.S. and Canada currently pursuing this most stringent of standards. Because Living Buildings encompass and considerably surpass minimum regulatory compliance standards, a wide-ranging set of issues arise for both the practitioners involved with creating these projects and for those responsible for regulating them. As more and more Living Building projects move from the conceptual stage into design and construction, it has become clear that obstacles in the regulatory realm present barriers to getting these projects approved and built. This report outlines code, regulatory and systemic barriers while providing rationales, recommendations and incentives for moving beyond current practices.

The movement to raise the level of consciousness about the environmental, social and economic implications of the built environment is growing rapidly in size, sophistication, and maturity. The changes taking place on a daily basis in both the public and private sectors are unprecedented in scope, type and location (from local to international), yet they remain fragmented and inconsistent. This presents challenges for documenting and analyzing the current regulatory landscape. As a result, this report is merely a snapshot in time.

Building and development codes, standards, and regulations are beginning to respond to growing concerns about climate change, energy security, water shortages and finite resources. More complete understanding of risks and more integrated approaches to addressing them are emerging, with a long way yet to go. This report represents a milestone in that it looks at the underlining roadblocks that remain for projects moving beyond the realm of doing no harm to creating net environmental, social and economic benefits overall.

Goals

The long term vision for this report is to support parallel shifts in the planning, design, and construction of built projects and in the regulatory community that must approve and engage with them, towards greater restorative and regenerative goals. Though we acknowledge their importance, issues related to the ways that users of the regulatory system engage with it were beyond the scope of this project. This report:

- Reveals both the systemic challenges of the regulatory framework and the specific code and regulatory barriers that exist for design and construction teams pursing Living Building Challenge goals.
- Provides a picture of the roadblocks faced by Living Building projects to enable all parties involved (architects, engineers, builders, developers, and regulators – including those for the finance and investment, insurance and reinsurance sectors, policy makers, etc) to find common cause and increased effectiveness in addressing and overcoming them.
- Serves as a tool for regulators, policy makers, practitioners and consumers by making recommendations and proposals to remove existing roadblocks to Living Building projects and create strategies and resources to address emerging challenges.
- Maps out features of an integrated, inclusionary regulatory process and system to help address the current climate change, energy supply, water shortage and finite resources crises.
- Highlights the need to coalesce the regulatory system to facilitate the successful implementation of new green energy, building and infrastructure initiatives in the U.S.

Methodology

The process of creating this report involved extensive research and analysis to identify the range of issues that constitute regulatory barriers to the Living Building Challenge in both the U.S. and Canada. Because the Living Building Challenge is designed to push against the upper limits of current practice in so many areas, it raises issues that do not always show up in mainstream green building projects, and therefore required more in-depth research.

Information was gathered from twelve building projects, all in varying stages of development: six Living Building projects; one aiming for LEED Platinum; and five projects seeking similar goals to the Living Building Challenge though not targeting Living Building certification. Interviews were conducted with project proponents as well as with key industry informants for their perspectives on challenges and solutions-based knowledge. In addition, an extensive review of current literature illustrative of these issues was performed. This report contains an analysis of the barriers, key findings, recommendations, and a list of relevant resources.

OVERVIEW OF THE LIVING BUILDING CHALLENGE

The Living Building Challenge was originally developed by Jason F. McLennan with subsequent further development by the Cascadia Region Green Building Council to inspire the creation of true sustainability in the built environment. The Challenge provides benchmarks for project teams seeking to move beyond the levels of the LEED Rating Systems into a performance-based, post-occupancy evaluation of a project's efforts towards maximum efficiency and sustainability.

The evolution of the Living Building Challenge has been a response to a variety of trends in the building industry:

- the growing market demand for certified green buildings and the associated need for ever-evolving benchmarks to define standards for the design and construction of these buildings;
- the achievement of LEED- Platinum certification for several buildings around the country (some with zero or small first-cost premiums) signaling the need for defining the next level of high performance buildings;
- the growing awareness that major environmental trends, such as climate change, are directly linked to human resource use and from the building industry itself and the corresponding immediate need for responding to these issues.

The Living Building Challenge was established to purposely push the envelope on the current level of green building practices while also acknowledging current market conditions and realities. Where building code and other regulatory systems pose barriers, Cascadia's goal is to identify those barriers and work with a community of leaders towards solutions and incentives. The Living Building Challenge User Guide is itself a living tool designed to encourage dialogue on the necessary evolution of the building industry while supporting the adoption of higher standards. It is also intended to provide a performance-based approach to informing the design of region-specific, low impact, healthy, and resource efficient buildings.

Since its release, the Living Building Challenge has spurred great deal of interest and excitement in the green building community. Immediate uptake will likely be small due to the difficulty of the standard, from both an integrated design standpoint as well as the challenge of navigating innovative projects through the regulatory process, but over time more and more projects are expected to comply.

The Living Building Challenge is comprised of sixteen prerequisites within six performance areas, or Petals: Site, Energy, Materials, Water, Indoor Quality, and Beauty & Inspiration. For a project to earn the Living Building designation, all prerequisites must be met. The Living Building designation is based on actual post-occupancy performance rather than modeled or anticipated performance determined during the design phases. Therefore, buildings must be fully occupied and operational for at least one year prior to evaluation and verification that the prerequisites have been met.

LIVING BUILDING CHALLENGE 16 PREREQUISITES[1]

SITE
1. Responsible Site Selection prohibits development on or near ecological sensitive areas, and on areas defined as prime farmland or within the 100-year flood plain.
2. Limits to Growth requires development only on greyfield or brownfield sites.
3. Habitat Exchange states that for each acre of development, an equal amount of land must be set aside for habitat protection.
ENERGY
4. Net Zero Energy requires 100% of the building's energy needs supplied by on-site, renewable energy on a net annual basis.
MATERIALS
5. Materials Red List identifies and requires exclusion of a "Red List" of chemicals, commonly found in building materials, which pose serious risks to human and ecological health.
6. Construction Carbon Footprint requires offsetting the embodied carbon footprint of all construction-related activities.
7. Responsible Industry requires all wood products to be FSC-certified or come from salvaged sources.
8. Appropriate Materials/Services Radius identifies a series of geographic radii in which all materials and services for the project must be sourced.
9. Leadership in Construction Waste requires diversion of construction waste from landfill/ incinerator disposal.
WATER
10. Net Zero Water requires 100% of occupants' water use from captured precipitation or reclaimed sources.
11. Sustainable Water Discharge requires 100% of storm water and building water discharge to be managed on-site.
INDOOR QUALITY
12. Civilized Environment requires operable windows that provide access to fresh air and daylight for every occupiable space.
13. Healthy Air/Source Control requires strategies to eliminate pollutant introduction into the indoor environment.
14. Healthy Air – Ventilation requires design of the building to deliver air change rates in compliance with California Title 24 requirements.
BEAUTY & INSPIRATION
15. Beauty and Spirit requires projects to include design features intended solely for human delight and the celebration of culture, spirit and place appropriate to the function of the building.
16. Inspiration and Education requires publicly-available educational materials highlighting the performance and operation of the Living Building project.

1 Based on Version 1.3 of *The Living Building Challenge*

MODULE 2

A LARGER CONTEXT FOR RISK AND RESPONSIBILITY:

CODE, REGULATORY & RELATED SYSTEMIC BARRIERS TO LIVING BUILDING PROJECTS

Growing recognition of the nature and magnitude of negative impacts related to the built environment has driven the green movement and is now beginning to drive change in the regulatory sphere as well.

A LARGER CONTEXT FOR RISK AND RESPONSIBILITY:

CODE, REGULATORY & RELATED SYSTEMIC BARRIERS TO LIVING BUILDING PROJECTS

I. INTRODUCTION

A major shift is now underway in the relationship between the regulatory agencies responsible for overseeing building and development and the green building and sustainable development movement in both the U.S. and Canada. Growing recognition of the nature and magnitude of negative impacts related to the built environment has driven the green movement and is now beginning to drive change in the regulatory sphere as well. These impacts—environmental, economic, and societal—are slowly being understood in terms of the contribution the built environment makes to them, and the impact that triple bottom line concerns, in turn, have on the built environment. While most of these changes are positive, the current regulatory realms in the U.S. and Canada remain highly fragmented and continue to rely on outdated basic assumptions. We can no longer assume that we will have: a stable and predictable climate; adequate, affordable and available energy, water and other critical resources; or that the natural, life-supporting systems on the planet are robust enough to withstand the impacts of our growing population. The implications of these new realities, in particular the need to dramatically reduce atmospheric carbon and energy use, have just begun to be reflected in regulatory activities tied to the built environment.

Regulatory barriers to best sustainable practices can arise across the spectrum of approvals required, including: the full range of building, development and land use codes and standards; local government general, specific and comprehensive plans; regulations related to watersheds, wetlands, open space and habitat conservation; transportation; public health; public and private energy, water, stormwater, and wastewater utilities; restrictive covenants; and other laws and ordinances related to the built environment.

Six persistent patterns within the regulatory sphere contribute to these regulatory challenges. First is the way regulations come into being and the resulting lag in regulatory response: regulations are only created after problems have become serious, widespread and persistent enough to demand official action.

The second pattern is an underlying assumption by the regulatory community that the public will be adequately protected through the use of established minimum standards. The problem that arises from this assumption is that these minimum standards typically place no limit on the number of individual increments of "acceptable" harm and do not take into account the potential for serious cumulative harm. Nor do they acknowledge the scientific reality that there are thresholds of cumulative harm beyond which serious risk to human health or ecological system collapse is unavoidable. Cumulative systemic damage cannot be prevented if an unlimited number of increments of harm are allowed, even if each alone appears to provide more benefit than harm.

The third pattern is that risks are addressed independently—as if they exist in isolation rather than in the context of the whole systems from which they emerge—giving the entire regulatory sphere an ad hoc and fragmented nature. The existence of regulatory silos and boundaries that do not match the interconnected reality of the risks they are supposed to address leads to gaps and overlaps in authority, both of which are problematic.

The fourth pattern is the tendency within regulatory entities to resist dealing with emerging risks—especially risks of a different type or at a different scale than those previously recognized. There are many reasons for this resistance including lack of resources and staffing, constraints of authority and scope, and powerful insistence by private interests that the burden of proof of harm or risk is on those harmed or those responsible for safeguarding the public from harm, rather than on those whose actions are responsible for the harm.

Fifth, is a set of widely held assumptions that the public interest is fully represented in regulatory processes. This includes a general assumption about who the "public" is and what their interests are. In practice, it is more common for private interests to have full representation and not unusual for those with private economic interests to claim that safeguarding their assets is inherently in the public interest. The problem is readily evident given the usual absence in these regulatory processes of direct representation for human or ecosystem health, or for the interests of future generations.

Finally, there is little recognition of the difference between explicit goals and implicit goals within codes and regulations. Goals that are stated generally, but not defined and elaborated, cannot and will not be enforced. The result is widening regulatory gaps and confusion about what is required to safeguard public health, safety and welfare.

Among the consequences of the current situation is that many in the building regulatory community continue to view "green" and "sustainability" goals as either trying to maneuver their way around minimum code requirements or as optional goals that extend beyond their regulatory scope of concern or responsibility. Meanwhile, the green building movement, and in particular the goals of the Living Building Challenge, encompasses a significantly more comprehensive understanding of risk. Inherent in their approaches is the aim of taking responsibility for balancing the full risk profile of built projects—including all the current regulatory concerns—while simultaneously

seeking to address large, but currently unregulated risks to present and future generations and to essential ecological integrity.

The lag in grasping the seriousness of the risks together with fragmented regulatory responsibility produces the seeming clash of paradigms that makes it harder for the most deeply sustainable projects to gain approvals than for conventional projects that contribute directly to these larger risks.

Successfully addressing these rapidly emerging crises will require a variety of responses. These include creating a more holistic and comprehensive regulatory system, with integrated regulatory processes based on system principles and societal goals. These will require recognition of cumulative risk and system limits, a formalized anticipatory and precautionary focus, explicit representation for the welfare and rights of future generations, and a fundamental goal of enabling positive outcomes (not merely preventing negative ones). A shift is necessary in the regulatory paradigm as profound as the one that has been driving green building, sustainable development, and the regenerative design movements. The regulatory changes now underway must be viewed as first steps in creating this more comprehensive regulatory system and the collaborative partnerships needed to address the crises we will be facing for decades to come.

While some jurisdictions, regulatory entities, and individual regulators embrace the urgency of this challenge and are competing to be the "greenest," others remain entrenched in historic practices and continue as though little needs to change. This, along with the difficulty of staying current with all the changes taking place today, means that the applicability of the observations presented in this report will vary greatly by location and by the aspect of the regulatory realm discussed.

> ...the current regulatory realms in the U.S. and Canada remain highly fragmented and continue to rely on outdated basic assumptions. We can no longer assume that we will have: a stable and predictable climate; adequate, affordable and available energy, water and other critical resources; or that the natural, life-supporting systems on the planet are robust enough to withstand the impacts of our growing population.

II. FEATURES OF CURRENT REGULATORY PROCESSES

It would be difficult for anyone to fully comprehend the complexity, experience, and wisdom contained in current regulatory systems related to the built environment, let alone the effort that has gone into creating them. There is an enormous body of regulations of different types that apply to built projects, with variability from one jurisdiction to the next.

There have been many efforts to harmonize codes, standards and other regulations. In the U.S., the consolidation of the three regional model building codes and their organizations into the International Code Council and the I-Codes provided the opportunity to review those codes and improve them. Nonetheless, a great deal of regulatory fragmentation persists, in large part because building codes represent only a fraction of the regulatory requirements governing built projects. While some fragmentation exists within the codes and standards, the absence of a larger, comprehensive regulatory framework designed to integrate all the regulatory responsibilities associated with the built environment hinders the effectiveness of all of the parts and of the overall system.

The regulatory sphere related to the built environment is typically thought to include building, land use and zoning codes and standards; aspects of transportation, stormwater, and utility regulation for water, wastewater, gas, electric, and sometimes communication systems; and the array of private restrictions and covenants placed by homeowners associations and other entities. Nearly all of these are focused at the project site level. What is not typically recognized is that many aspects of utility regulation prevent or reduce the potential to fully utilize or optimize site resources such as solar, wind, surplus or "waste" heat, and water resources in or among buildings and across roads or property lines. Huge amounts of energy and water are wasted because older regulations, designed to protect public and private utilities, prevent optimizing the potential public benefit of the most effective use of scarce and expensive critical resources.

Today's regulatory environment has sizable gaps as well as overlaps and conflicts in roles and responsibilities. Where regulatory gaps exist, risk is typically externalized to everyone—to the commons (the clean air and water, healthy land, natural resources, and natural systems that are our common birthright) and to future generations. Examples include the massive but unregulated contribution of the building industry to global warming, to a wide range of negative impacts to ecosystem and human health, and to depletion of critical non-renewable resources, all of which affect other spheres of human need beyond the built environment.

Where there are overlaps, compliance is made more difficult by conflicting priorities or regulations, or by competing jurisdictional authority. This increases the difficulty for projects pursing the Living Building Challenge in gaining approval for alternative or innovative practices, and in making needed changes to the regulations themselves. Further, jurisdictional overlap can have the effect of relieving both entities of full responsibility for enforcement or regulation.

The changes now needed require a fundamental rethinking of the legal assumptions upon which almost all regulatory activity is currently based. The situation is clearly outlined in a recent paper by Joseph H. Guth, J.D., Ph.D, Legal Director for the Science and Environmental Health Network, entitled Cumulative Impacts: Death-Knell for Cost-Benefit Analysis in Environmental Decisions[2]. According to Guth, our legal system broadly assumes that we can tolerate all increments of environmental harm that individually appear outweighed by greater accompanying economic benefits. However, numerous studies are telling us that the cumulative impacts of our economic activities are degrading the Earth's capacity to support humans. Therefore, humans will have to abandon the use of cost-benefit analysis to justify individual environmental impacts and, instead, focus on limiting our cumulative impact to a sustainable size.

2 Guth, Joseph H. "Cumulative Impacts: Death-Knell for Cost-Benefit Analysis in Environmental Decisions" 11 Barry L. Rev. 23 (2009), summarized at http://www.precaution.org/lib/09/ht090219.htm#Cumulative_Impacts _Death_Knell_for_ CostBenefit_Analysis and Guth, Joseph H. "Law for the Ecological Age," *Vermont Journal of Environmental Law*, vol. 9, Issue 3, pp. 431-512 (Spring 2008) http://www.vjel.org/journal/pdf/VJEL10068.pdf

A Brief History of U.S. and Canadian Building Codes

The first known building code was included in Hammurabi's code of laws, circa 1700 B.C.E. The Babylonian king of Mesopotamia ruled that the builder of a house should be put to death if a building he constructed fell and killed its owner. Building codes became less draconian but far more specific as they responded to damage and loss of life from fires, earthquakes, and other building failures. Steps along the way included London regulations in 1189 A.D. for the construction of common walls and for rights to light access, drainage, and safe egress in case of fire; US Colonial-period bans on wood chimneys and thatch roofs; and the New York City Tenement House Act of 1867 covering such things as fire escapes, ventilation, water supply, toilets, and stair railings. In 1905, the National Board of Fire Underwriters, an insurance industry group, wrote the first National Building Code for the United States. Seismic codes were adopted in many geologically active areas following the San Francisco earthquake in 1906. By 1940, three different code organizations had been established in the United States, with model codes that reflected regional variations and made it difficult to work across different code-enforcement areas. Decades of efforts to harmonize the three codes ultimately resulted in the creation of the International Code Council (ICC) family of codes, the first full edition of which was published in 2000. Included in the 11 codes making up the ICC family were the International Building Code, International Residential Code, and "International" versions of the Mechanical, Plumbing, Fire, and Energy Conservation codes (the National Fire Protection Association later split from the ICC process and began developing its own building code to compete with the ICC)[3].

In Canada, responsibility for building regulation lies with the provinces and territories. Originally this responsibility was delegated to individual municipalities, resulting in increasing variations across the country and creating problems for designers and product suppliers. In response, the National Research Council developed the first National Building Code (NBC) of Canada, a model code for adoption, in 1941. The Canadian Commission on Building and Fire Codes is responsible for building code development in Canada – as well as plumbing and fire codes. The code has been updated about every five years, though the commission has proposed to revise the national building code update cycle to every three years. Provinces and territories have limited the inconsistency between jurisdictions by adopting a provincial or territorial standard code (either the NBC in its entirety or the NBC with modifications) for use by their local municipalities. The Model National Energy Code for Buildings and the Model National Energy Code for Houses are voluntary standards which exceed the national building code's requirements[4].

Guth cites the 2005 United Nations Millennium Ecosystem Assessment, a five-year study of the condition of the Earth's ecosystems by 1360 world scientists, which states: "At the heart of this assessment is a stark warning. Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted." [5] Additionally, the United Nations-sponsored Global Environment Outlook (GEO4), published in 2007, reports that human activity now needs 54 acres (22 hectares) per person globally, but Earth can support only 39 acres (16 hectares) per person without suffering permanent degradation.[6] We have exceeded the Earth's carrying capacity.

3 Wilson, A., Atlee, J. and Webber, D./Halsall Associates, PAPER 3b: *Institutional Efforts for Green Building Approaches in Canada and the United States*, Commission for Environmental Cooperation, March 2008. Discusses both U.S. and Canadian code development. http://www.cec.org/pubs_docs/documents/index.cfm?varlan=english&ID=2238

4 Persram, Sonja. *Report from the Toronto Green Building Festival 2006*, December 11, 2006: http://www.igreenbuild.com/cd_2704.aspx. *See also previous note*.

5 *Millennium Ecosystem Assessment*. United Nations. 2005. http://www.millenniumassessment.org/en/Global.aspx

6 *Global Environment Outlook: environment for development (GEO-4).* United Nations Environment Programme. 2007. http://www.unep.org/geo/geo4/media/index.asp

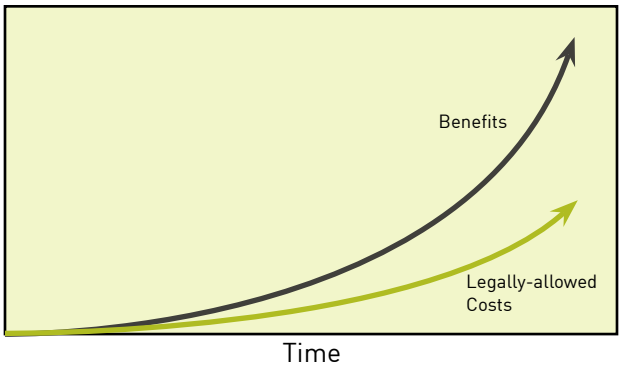


Figure 1: The law promotes all econoimc activity having a net benefit, allowing both benefits and costs to grow forever as the economy grows

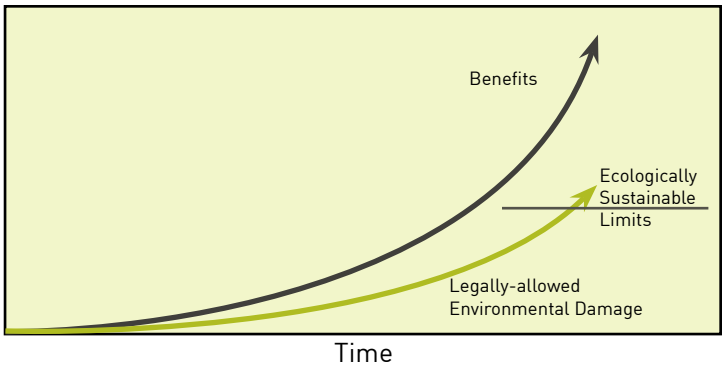


Figure 2: As the economy grows, cumulative environmental damage must eventually surpass the Earth's ecologically sustainable limits.

These two graphs from *Cumulative Impacts: Death-Knell for Cost-Benefit Analysis in Environmental Decisions*, by Joe Guth, illustrate the flaw in allowing unlimited incremental harm in the form of "acceptable risk" without taking into account cumulative risk and actual natural system limits.

The reliance on minimum standards rests on using cost-benefit analyses to establish acceptable levels of harm or risk. The assumption on which this approach is based is that economic growth is an assumed good with unlimited potential for continuous growth, which is also an assumed good. Though there is recognition of an increment of ecological harm accompanying economic activity and growth, the assumption is that economic activity and growth should always be allowed as long as it cannot be proven that the cost to society of each increment of harm is greater than the benefit of the activity. Thus, it is also assumed that the incremental harm can grow without limit, but the total harm will always be less than total the benefit. The two figures above show the literally fatal flaw in this theory—the indisputable reality that there are, in fact, cumulative impacts that are not accounted for in this model, and real limits to the ability of humans and ecosystems to withstand that cumulative harm without dire consequences for both. No matter the size of the cumulative benefit, once the cumulative harm reaches a threshold that results in ecological collapse–when the earth cannot sustain the human population, the cost of each theoretically "acceptable" increment of harm becomes infinitely large, outweighing any potential societal benefit. The world scientific community has been warning of this approaching reality for decades. It is now clear that risk cannot be safely managed in this incremental, non-systemic way, because this leads also to the greatest economic harm – collapse of the entire system. While this is a larger matter than can be properly addressed here, it is introduced because it reveals the need for legal and regulatory systems that respond to our current circumstances and understanding of system principles, science and need for precaution, underscoring the need for a paradigm shift in our thinking.

There has never been a comprehensive public process to articulate societal goals, assess overall regulatory needs and relationships to support those goals, and then design a coherent regulatory system. Our regulatory structures do not yet recognize current scientific understanding that local and global ecological degradation resulting from cumulative impacts are undermining the ability of ecosystems to sustain human life. This comprehensive reassessment is needed now.

How did we get here?

The current situation is understandable when viewed from the standpoint of how regulations (and, to a degree, all regulatory entities) have come into being—generally through ad hoc efforts to respond to disaster, failures, and other persistent problems that rise to a level of seriousness demanding official response. The problem is that this typically has been achieved through independent processes in different regions, embodying diverse concerns, agendas, levels of expertise, criteria, goals, interests and strategies. This historic pattern leads to fragmentation and new problems, some of which emerge from the regulatory paradigm itself. The following is a discussion of the six persistent patterns within the regulatory sphere that create or have contributed to these challenges

First, the main navigational tool in the regulatory arena is the rear-view mirror.

As mentioned above, the current regulatory paradigm is essentially reactionary and lacks an anticipatory capability. Because the rationale for regulations is to address significant existing problems, it is difficult to generate regulatory responses to problems or risks when they are small and more easily managed or avoided. Regulatory entities tend to resist the significance of emerging risks until they are large and serious. This is demonstrated by the regulatory system's decades-long delay in acknowledging the urgent risks that spurred the green building and sustainable development movements into existence. This delay is partially due to the finite resources available to support regulatory agencies, limits to the scientific research needed to document these emergent problems, and limitations in regulatory authority. A contributing factor is the role that private interests play in impeding regulatory responses to risks related to their activities. Particularly problematic are cases where formerly unrecognized or unregulated risks become known, such as health risks from persistent toxic chemicals found in common building materials. If the risk is of a new kind related to practices or products formerly assumed to be safe, the challenges to both regulators and those proposing safer alternatives are often significant. This issue is increasingly important as the rates of change in both human and natural systems are increasing. A formal mechanism to continuously acknowledge and quickly respond to emergent and changing risks must be designed into the regulatory system.

Second, the dependence on minimum standards keeps the focus on the least, often at the expense of the best.

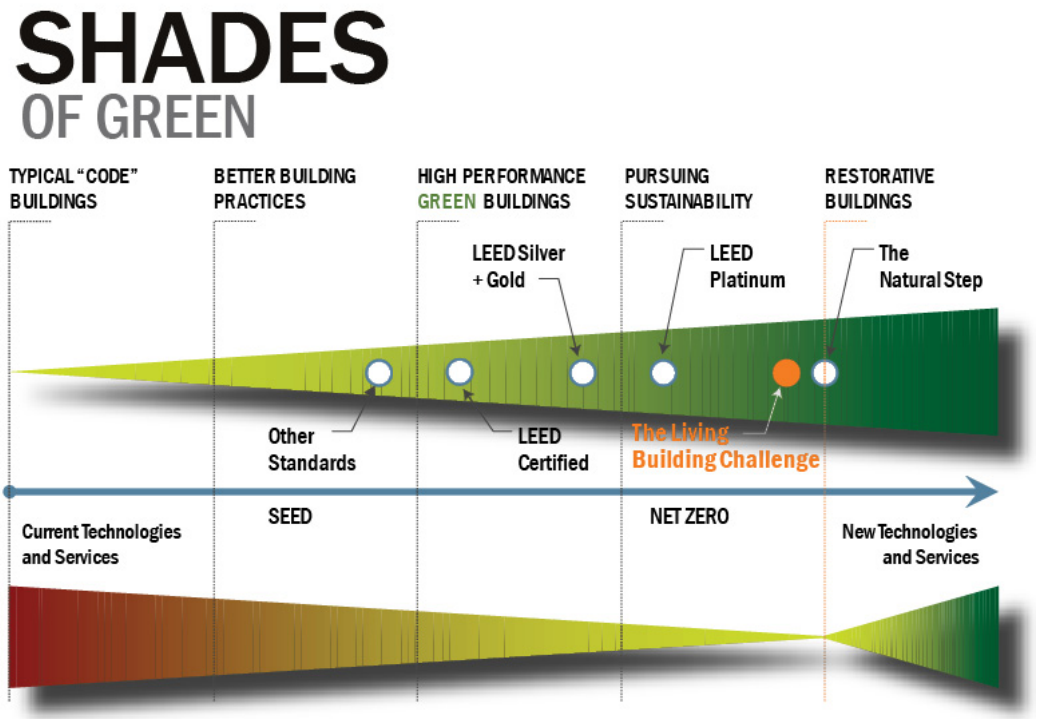
Minimum standards tend to focus regulatory attention on the least that will be allowed in order to prevent or minimize harm or risk. As laudable and important as this goal is, the result is a policing mindset aimed at making sure that nothing falls below the established thresholds. From that point of view, enabling and approving best practices, especially those that differ substantially from mainstream practice, often seems risky and time-consuming, and tends to make above-minimum efforts appear extravagant or unimportant. Consequently, those striving to achieve the best outcomes will frequently encounter worse treatment (such as lengthy appeals or variance processes) during the regulatory process than those just meeting minimum requirements.

The efforts to develop local, regional and national green building standards or rating systems in the U.S. and Canada have brought disparate interests together to establish minimum standards of performance for green buildings. Similar efforts are underway for land use and development codes including tools, standards and recommendations from the Smart Growth[7] movement and the Rocky Mountain Land Use Institute[8], among others. Organizations such as the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and the American Society for Testing and Materials (ASTM) are striving to develop appropriate standards for green or sustainable building that could be referenced by codes. While more comprehensive and holistic than current regulatory requirements, most green building programs, rating systems, and standards follow the historic pattern of relying on minimum standards.

Conversely, the Living Building Challenge establishes a comprehensive set of criteria aimed at positive outcomes, eliminating practices that are harmful while allowing innovative approaches to meeting positive objectives like self-sufficiency in water and energy, and healthy indoor and outdoor environments. These higher goals are not tied to minimum standards. The difference is significant—aiming to support health and vitality in both human and natural systems through projects that generate more overall benefit than harm across the spectrum of their impacts and from the project site to the neighborhood, community and larger ecosystem in which they are located.

7 The Smart Growth Network. http://www.smartgrowth.org/

8 *Sustainable Community Development Code Reform Initiative*. Rocky Mountain Land Use Institute. http://www.law.du.edu/index.php/rmlui/sustainable-community-development-code



Citation: The diagram above, courtesy of SERA Architects, highlights the continuum of building practices across the spectrum of their ecological impacts, from code minimum to restorative buildings. Restorative or regenerative describes the ability for human and natural systems to cooperatively support each other indefinitely, by improving the ability of the whole system to continually co-evolve toward greater health, vitality, and integrity.

Alex Zimmerman and Charles Kibert have observed that the Leadership in Energy and Environmental Design (LEED®) green building rating system would benefit from greater attention to scientific principles[9]. Focusing on individual environmental impacts "does not adequately recognize major, step-change or paradigm-shifting advances," they note. This contributes to "end-of-pipe mindsets and incremental solutions." In the continuum of building practices, from minimum code to the Living Building Challenge and beyond, incremental improvements cannot achieve regenerative or restorative goals. Frameworks such as The Natural Step[10] and the Precautionary Principle[11] can serve as useful tools to move beyond the limitations inherent in reliance on minimum standards.

Third, risks are treated as discrete problems and not addressed in context.

The reactive nature of the regulatory process fosters a tendency to see and address problems individually through discrete, non-systemic actions, rather than in relationship to other risks and as part of a systems-based response. This fragmented approach to risk manifests at all scales, from specific provisions in codes and standards to the structure of regulatory responsibility and authority. One result is that risks are not understood in their full context, leading to greater unintended consequences.

The silos of regulatory jurisdiction are relatively artificial and arbitrary compared to the deeply interrelated nature of actual risks—whether across departmental, organizational, geographical, political, or discipline-based jurisdictional boundaries. The resulting regulatory gaps and overlaps

9 Zimmerman, Alex and Kibert, Charles J. "Informing LEED's next generation with The Natural Step," *Building Research and Information*, Volume 35, Number 6, November 2007 , pp. 681-689(9), Routledge, part of the Taylor & Francis Group: http://www.ingentaconnect.com/content/routledg/rbri/2007/00000035/00000006/art00008?token=00461e545ee3e146d8e5475c5f3b3b476728482825447b2a2b6d5f3f4f58762f679b28. A previous version was written by Zimmerman in 2006.

10 http://www.naturalstep.org/

11 Precautionary Principle: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. The process of applying the precautionary principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action." The Science and Environmental Health Network. http://www.sehn.org

complicate and impede effective management of risk. Without a full and comprehensive framework within which to address risks, they are often not reduced or eliminated but merely moved in space and time—moved away from the building site out into the natural, life-support systems of the Earth, and from the present to the future.

The focus on preventing harm only within previously defined categories of risk means that innovative attempts to address both currently recognized risks and emergent risks simultaneously are often seen by regulators as riskier than current practices, and rejected. Holistic solutions to risks that extend across regulatory boundaries pose problems for the regulators who operate within tight and fragmented codified constraints. The fact that the regulatory realm struggles with comprehensive and balanced efforts to address more inclusive categories of risk than required by current regulation indicates a problem within the realm. In the absence of a broader understanding of risk and the guidance that would be provided by system goals and principles, the focus remains on preventing specific known risks in isolation. The net result is a tendency to discount both the seriousness of emergent risks and the viability of lowering overall risk through more holistic approaches.

Systems and organizational management leader Russell Ackoff wrote, *"English does not contain a suitable word for 'system of problems.' Therefore I have had to coin one. I choose to call such a system a 'mess.' The solution to a mess can seldom be obtained by independently solving each of the problems of which it is composed"*[12]. Additionally, Paul Hawken and Amory and Hunter Lovins wrote in their book Natural Capitalism, *"Optimizing components in isolation tends to pessimize the whole system"*[13]. These two observations highlight a common tendency in building codes and other regulations that runs counter to leading-edge design and development, where significant performance breakthroughs are based on deeper integration and more systematically-addressed risk and benefit.

The development of the integrated design process has opened a way for design and construction teams to view their projects in terms of whole systems and sets of interrelated systems, which is key to meeting Living Building Challenge criteria. This integrated process allows everyone with something to contribute to collaborate on developing solutions that work together and reinforce each other—as a system— in order to create cost-effective, high performance projects. The further evolution of the integrated design process involves understanding that building projects are also embedded in human and natural systems, with the goal of optimizing all the beneficial relationships within those systems. The performance, and thus the success, of the project depends on maintaining the integrity of the whole design and all its interdependent parts.

A parallel process is needed in the regulatory realm. The traditional approvals process, with its disciplinary and jurisdictional silos and linear nature, means the integrity of the whole design can be undone anywhere along the approvals process. The highest performing projects rely heavily on the relationships between all design elements in order to meet sustainability goals including orientation, fenestration, overhangs, massing, thermal envelope, roof design, daylighting, mechanical systems, materials choices, and more. If any of those interdependent features are not approved, significant redesign of other systems or parts of the building may be required in addition to having to redesign the feature that is rejected. This presents significant risks for design teams and project owners when pursuing deeply integrated designs.

Involving regulatory officials early and throughout the integrated design process would help overcome this obstacle. When those tasked with enforcing the codes and regulations are present during the design process, their concerns, input, understanding and expertise will be present at critical times in the same way that other important stakeholders and participants are included. Thus the likelihood of serious approvals problems would be greatly reduced.

12 Ackoff, Russell. *Systems, Messes and Interactive Planning: The Machine Age*, from *Redesigning the Future*, New York, Wiley, 1974, http://www.moderntimesworkplace.com/archives/ericsess/sessvol3/Ackoffp417.opd.pdf

13 Hawken, Paul, Lovins, Amory and Lovins, L. Hunter. *Natural Capitalism: Creating the Next Industrial Revolution*, Little, Brown (1999): http://www.natcap.org/images/other/NCchapter6.pdf

Fourth, the tendency for regulatory entities is to resist recognizing and addressing new and emerging risks.

This pattern lays the foundation for conflicts between those pursuing deep green goals and regulators who believe that the currently regulated hazards they are familiar with are more important and serious than any newly identified hazard not yet incorporated into the regulations they enforce. Beyond the natural reluctance many people have toward change, is a set of factors that make both individuals in regulatory entities and the entities themselves resistant to accepting responsibility for new risks.

These factors include the psychological investment in cumulative experience; fluency with current regulations and standard practices; and the real and perceived risks inherent in learning how to do something differently. There are also practical limitations imposed by lack of capacity to take on new tasks or responsibilities, such as lack of staff, training or other resources, and constraints based in the authorizing laws, policies or regulations. This is a persistent pattern that can be seen today in the continued poor adoption and enforcement of building energy codes, in the difficulty in removing known toxic or harmful substances like formaldehyde from building materials; or the decades it took to abolish the use of asbestos, lead in paint and plumbing solder, or arsenic and heavy metals in wood preservatives.

Sometimes political and economic interests make it challenging to begin to address practices that had formerly been deemed safe and are now known to be hazardous. No matter what the source (or sources) of resistance, it is not uncommon to hear the argument that regardless of the level of seriousness of the new risk, there can be no compromise in meeting existing regulatory requirements. This is based on the presumption that no serious risks are inherent in currently accepted practice. Until there is acceptance of those inherent risks, it is extremely difficult to convince a regulator that a non-standard practice that addresses the new risk and meets the intent of the current regulations could be as safe or safer.

Fifth, the current level of public interest representation in regulatory development processes is inadequate.

There are a variety of processes through which regulations, codes and standards are developed. Today most are open processes that anyone with an interest can attend, though participation on the committees that develop and modify codes and standards is limited in an attempt to seek balance among membership. In the U.S., the national organization that authorizes and certifies standards development processes is the American National Standards Institute (ANSI). ANSI certification depends on protocols that establish an open and balanced committee and approval process aimed at ensuring all substantive objections from public review and balloting are resolved to the satisfaction of the committee. The ANSI process is based on four principles[14]:

- Openness–Any materially affected and interested party shall have the ability to participate.
- Balance–Participants should represent diverse interests and categories, and no single group should have dominance in standards development.
- Due Process – All objections shall have an attempt made towards their resolution. Interests who believe they have been treated unfairly have a right to appeal.
- Consensus – Agreements are reached when more than a majority but not necessarily all of the participants concur on a proposed solution.

The International Code Council (ICC) has a slightly different code development process for their codes than the ANSI process[15]. Anyone can propose a code change and all proposals are considered by committees appropriately structured to represent balance in their membership. After the

14 http://www.ansi.org/about_ansi/faqs/faqs.aspx?menuid=1

15 International Code Council: http://www.iccsafe.org/cs/codes/

committees have reviewed the submitted code change proposals and made their recommendations, ICC voting members—the public officials responsible for administering and enforcing the codes—must ratify the decisions of the committees. In the ICC process, the final decision about code changes is left to the judgment of public officials who are responsible for safeguarding public health, safety and welfare—rather than those with a private interest.

The assumption is that the open, voluntary, and public nature of these processes results in the public interest being adequately represented. While the ICC process has the benefit of giving final say in code changes to those responsible for safeguarding the public, that does not guarantee that the public interest is always fully protected. The current regulatory system for the built environment does not require explicit or continuous representation of the public interest in areas such as biology, ecology or other physical and life sciences, or for public health, resource conservation, climate mitigation and adaptation, building science, and, of crucial and growing importance, representation for the rights and welfare of future generations. While it can be assumed that those with material financial interests will always be represented, it should not be assumed that the most current scientific knowledge, relevant public health concerns, or sustainable building and development expertise will be included in codes and standards development processes.

While this report was being written, the development of a national commercial green building standard in the U.S., ASHRAE Standard 189P, was put on hold and the committee was reconstituted in response to pressure from several industry sectors complaining that they were not represented on the committee[16]. This highly unusual action was taken although the process establishing the committee was carried out in accordance with the prescribed criteria for standards development in the U.S. Regardless of whether the larger, reconstituted committee contains additional representation for public as well as private interests, a question worth asking is whether a similar complaint about inadequate representation from a group or groups representing the public interest, in terms of human or ecological health or social equity, would have the same result –the reconstitution of a standing committee in order to accommodate their request for membership.

Without adequate support for public interest representation, this will continue to be the case. Private interests typically pay professionals to "volunteer" for these committees and have both the financial resources and the incentive to participate fully in every meeting. Those representing the public interest often do so at their own expense and commitment of time, and those lacking the financial ability to do so are left out of the process.

A related issue is the lack of financial support for representation in regulatory processes for non-commodified materials, systems or designs that, while environmentally preferable, are either in the public domain (such as adobe, rammed earth, or straw bale construction) or are not product based (such as passive design strategies or greywater and water harvesting systems that can be constructed using standard off the shelf components). Without balanced recognition of the full risk profile of competing alternatives, those without financial backing are likely to lose out regardless of their actual performance or benefits[17].

Sixth, there is little recognition of the difference between explicit versus implicit goals.

A final problematic tendency is that regulations do a good job of meeting goals that are well-defined and explicitly addressed within regulations. The problem is that not all goals are explicit. When both implicit and explicit goals are present, the implicit goals nearly always fall through the cracks. For a variety of reasons, the implicit regulatory goals included in purpose and intent statements or in authorizing legislation often remain undefined and thus their associated risks go unaddressed. Both explicit and implicit goals can be seen in the purpose statement from the 2006 International Building Code:

16 "Building Green," *Uncertain Future for ASHRAE Standard 189*: http://www.buildinggreen.com/auth/article.cfm/ID/4056/

17 http://files.eesi.org/Eisenberg_062008.pdf and http://www.eesi.org/062008_Straw-Bale_Construction

> **101.3 Intent.** The purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations.

This statement provides no specific indication about what constitutes "other hazards" attributed to the built environment, nor are "health" and "general welfare" defined here or elsewhere in the code. Unlike the list of explicitly defined goals, safeguarding public health and general welfare are implicit goals, and because they are undefined, are unenforceable.

In this passage from *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, a book that should be required reading for anyone engaged in managing or dealing with complex systems, Dietrich Dörner explains:

> *"...in complex situations we cannot do only one thing. Similarly, we cannot pursue only one goal. If we try to we may unintentionally create new problems. We may believe that we have been pursuing a single goal until we reach it and then realize...that in ridding ourselves of one plague we have created perhaps two others in different areas. There are, in other words, "implicit" goals that we may not at first take into account at all and may not even know we are pursuing. To take a simple example, if we ask someone who is healthy about her goals, she will not normally name "health" as one of them. It is, nevertheless, an implicit goal, for if we were to raise this point specifically, she would agree that maintaining her health is important. In general, however, health will become one of her explicit goals only if she falls ill.*

> *"...People concern themselves with the problems they have, not the ones they don't have (yet). Consequently, they tend to overlook the possibility that solving a problem in area A may create one in area B."*

In pointing out the need to broaden the focus of codes, it is noteworthy that the act of focusing is, by definition, exclusionary. When we focus on something we exclude everything else. The illustration below demonstrates the explicit risks that building codes have tended to focus on (left), and a galaxy of some of the larger, implicit, and long-term risks (right), directly attributable to the built environment. These latter risks are not regulated by the entities assumed to be responsible for safeguarding the public from harm tied to the built environment. Nor is there awareness that activities addressing risks on the left are contributing to and possibly amplifying unregulated risks on the right.

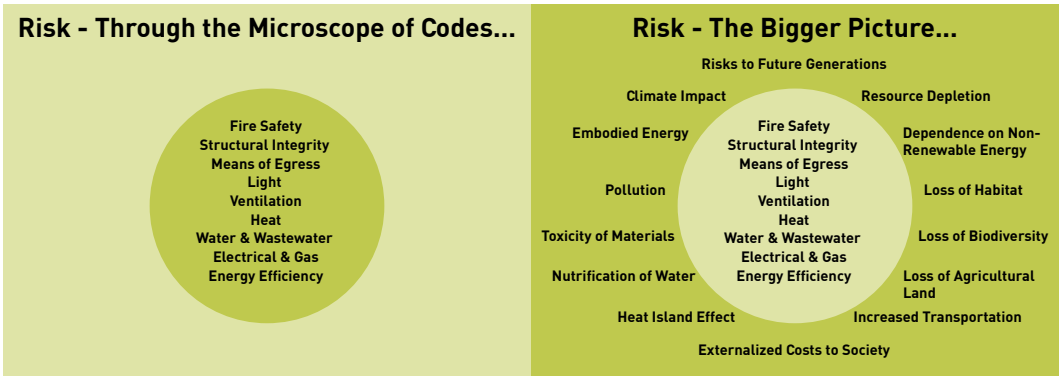


Diagram courtesy of the Development Center for Appropriate Technology – Copyright DCAT, 2000

These larger, longer-term risks pose significant public health and other hazards, yet while clearly within the regulatory purview and authority of building codes, they are not addressed there because public health is an implicit goal for the building codes community. The existence of other agencies and authorities with explicit responsibility for public health is a contributing factor. In a fragmented regulatory system, where responsibility for addressing a risk can be externalized from the system, it will be externalized. Consequently, chronic risks happening slowly over time, risks that may have complex causes overlapping with other regulatory or jurisdictional authority, or risks distant from the building site—such as the contribution of buildings to climate change—can be large and serious, yet not result in a regulatory response.

In the concluding chapter of *The Logic of Failure*, Dörner writes:

> *"As a rule we do not give adequate attention to the characteristics of processes that unroll over time ... We must learn that events not only have their immediate, visible effects but long-term repercussions as well.*
>
> *"We also must learn to think in terms of systems. We must learn that in complex systems we cannot do only one thing... any step we take will affect many other things...We must understand that the effects of our decisions may turn up in places we never expected them to surface."* [18]

A clear example that demonstrates the set of problematic patterns described above can be seen in relation to fire retardants in foam insulation. According to the Green Science Policy Institute: *All polystyrene foam insulation used in building insulation (both XPS, such as Styrofoam, and EPS) is treated with hexabromocyclododecane, (HBCD), a persistent, bioaccumulating, and toxic fire retardant. This chemical was recently nominated for the first EU list of sixteen "Substances of Very High Concern" and will likely be banned in Europe. It has been widely detected in household dust, sewage sludge, breast milk and body fluids as well as wildlife and the global environment. Polyisocyanurate (polyurethane) board often contains TCPP (tris (1-chloro-2-propyl) phosphate). While its toxicity in mammals appears to be limited, the effects of long-term exposure are unknown, and it is toxic in aquatic environments. Polyurethane boards can contain up to five percent "blowing agents", which are usually volatile hydrocarbons or halogenated hydrocarbons. Polyurethane spray foam formulations can contain both blowing agents and proprietary fire retardants with unknown composition and health effects.*[19]

In the current building regulatory system these types of human and ecological health issues rarely emerge from within the codes community. Instead, they typically are only addressed when public health or environmental protection agencies mandate a regulatory response. It takes sustained, determined action on the part of those who have documented such risks to prohibit the use of these substances even when effective, safer alternatives are available. There are no current regulatory tools to determine and set overall limits of exposure, though foam insulation can contain 10% or more of these chemicals by weight. Widely required by building codes for their fire safety benefits, these chemicals are on the Living Building Challenge Materials Red List because of their recognized risks and as such, are banned from projects pursing Living Building status. Risks serious enough to be identified implicitly should be serious enough to also require explicit definition and enforcement.

18 Dörner, Dietrich. *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*. Perseus Books, Cambridge, MA 1996

19 "The Fire Retardant Dilemma: Should Green Buildings Contain Toxic Fire Retardant Chemicals?" Green Science Policy Institute. http://greensciencepolicy.org/?page_id=28

III. REGULATORY BARRIERS BEYOND CODES AND STANDARDS

Regulatory barriers to Living Building projects extend beyond the areas that are ordinarily considered in relation to regulation of the built environment. Other areas impacting the built environment include insurance and reinsurance, finance and investment, tax policies, energy and water policies, and the incentives, disincentives, and subsidies that play a role in enabling or disabling more sustainable products, systems, and projects. Chris Corps of Asset Strategics noted in a Commission for Environmental Cooperation background paper on sustainable financing: *"The first challenge (in the move to broader valuation) is to ... move beyond a single way of looking at how value is defined, to recognize environmental, financial, ecological, cultural, social and other aspects."*[20]

Although they are not usually included in discussion of the regulatory barriers to the built environment, all of these areas impact public health, safety and welfare –as well as private and public purses. Similar to the way codes and standards lead to the internalization or externalization of responsibility for risk, the regulation of these sectors either supports or inhibits projects with sustainable goals. Only a small selection of this type of barrier is included within this report while acknowledging their wider existence and influence. The following is an analysis of barriers in the regulation of insurance, reinsurance, finance and investment in relation to the built environment.

Insurance and reinsurance sectors responsiveness to climate change and other risks

Awareness of the cost of inaction on climate change risks is growing. Finance, insurance, investment, building, and planning regulators that are informed about these costs can be expected to play a significant role through regulations and incentives.

Action on these fronts has already begun in the insurance and reinsurance sectors, which increasingly are concerned about risks related to climate change and other environmental matters. This is heightening their interest in green buildings. Mills et al. note that addressing climate risk should include supporting improved building and land use codes, and the uptake of energy-efficient and renewable technologies that facilitate mitigation of both their customers' risk exposure and their greenhouse gas emissions.[21]

If conventional, non-green practices around the built environment were accurately perceived as incorporating greater risk, there would be an enormous leveraging of debt, investment and insurance instruments to facilitate the movement towards greater sustainability measures. The insurance sector has shown leadership in this regard. Over 422 insurance companies developed 190 actions as risk reduction measures responding to global warming and climate change according to the report *From Risk To Opportunity 2007: Insurer Responses to Climate Change.*[22] These measures included financing customer improvements and aligning terms and conditions with risk-reducing behavior. Additional measures will likely emerge over time as more data from post-occupancy evaluations of productivity and building performance in workplaces further substantiate green building benefits. Support for preferential green insurance premiums for life and health as well as for Employee Assistance Programs is anticipated over time.[23]

At the same time, gaps in building regulation have also led to measurable financial losses for the insurance sector. Evan Mills, energy scientist at Lawrence Berkeley National Laboratory notes

20 Corps, Chris. "Background Paper 2c: Toward Sustainable Financing and Strong Markets for Green Building: Valuing Sustainability" Commission for Environmental Cooperation, 2008

21 Mills, E. and I. Knoepfel. "Energy Efficiency Options for Insurance Loss Prevention." Proceedings of ECEEE Summer Study, June 1997, cited in Mills, Evan, From Risk to Opportunity: Insurer Responses to Climate Change, CERES, 2007

22 Cogan, Douglas G. *Corporate Governance and Climate Change: Making the Connection*, CERES, 2003

23 Persram, Sonja. *The Greening of Corporate America SmartMarket Report: A review*, May 14, 2007, iGreenBuild.com. Employee Assistance Programs are employer-supported counseling services for employees that impact employee retention; when natural views and enhanced indoor environments improve mood and lower stress this could be expected to reduce employer outlays for these programs.

that an examination of post-Katrina economic losses on a per-capita basis shows regions utilizing building codes and extensive land-use planning experienced three-times-lower losses.[24] Mills also observes that the insurance industry regards the inclusion of durability and disaster-resilience as important in green building rating systems such as LEED.[25] He adds that only regulatory mandates for the insurance sector could require that all companies act on climate issues.

The size of the financial risks is driving insurance and investment sectors towards internalization strategies to reduce future threats. Insurance advisory firm Marsh calls for recognition of business risks from climate change, including corporate preparedness around hazards arising from increasingly unpredictable weather, notably rising sea levels, health impacts, and the resulting influence of these factors on markets for insurance, business assets and human resources.[26]

Finance and investment: fiduciary responsibility, appraisal and value

Since portfolio managers are entrusted with the financial or investment assets of their stakeholders, they would be expected to continually identify and act to mitigate risks anticipated to affect the current or future value of these assets. Their actions would address their own company's risks, as well as those of their clients, investors and other stakeholders. Consequently, it can be expected that lenders would recognize higher value for green buildings and also acknowledge these differences in their portfolios. As well, the lending community, to control their corporate and portfolio risk exposure, could take measures to address environmental and social challenges and opportunities.

However, lending and investment regulations do not yet broadly demonstrate this responsibility. Further, failure to use life cycle financial analysis in building evaluations means building owners that minimize their climate change and other environmental and social risks are not fully recognized for doing so—and future benefits, such as lower operating and maintenance costs, are undervalued.

Some investment institutions do recognize the risks of climate change on portfolio operations. Jane Ambachtsheer of investment advisory firm Mercer observes that those responsible for investment accounts have a fiduciary responsibility to deal with climate risk.[27]

Climate change also creates potential liability for companies, governments and leaders who know but do not act in response to the scientific evidence now available.[28] The 2007 Greening of Corporate America SmartMarket Report,[29] produced by McGraw-Hill Construction and funded by Siemens, confirms that risk and liability were not yet significant factors in corporations' involvement in green buildings. Overall, the advantages of green buildings,[30] [31] [32] [33] and in particular those of the Living

24 Burby, R.J. "Hurricane Katrina and the Paradoxes of Government Disaster Policy," *Annals of the American Academy of Political and Social Science*, March 2006, cited in Evan Mills, "From Risk to Opportunity 2007: Insurer Responses to Climate Change," November 2007, http://216.235.201.250/NETCOMMUNITY/Document.Doc?id=225

25 Evan Mills. Personal communication with Sonja Persram, April 2008.

26 Marsh, Climate Change: Business Risks and Solutions. http://global.marsh.com/risk/climate/climates/documents/climateChange200604.pdf

27 Jane Ambachtsheer. *A Climate for Change: A trustee's guide to understanding and addressing climate risk*, 2005, Mercer http://www.mercer.com/summary.jhtml?idContent=1189970

28 *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant.* Report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate. United States Government Accountability Office. March 2007. http://www.gao.gov/new.items/d07285.pdf

29 *The Greening of Corporate America SmartMarket Report*, May 2007, McGraw-Hill Construction.

30 eBids – Energy Related Building Investment Decision Support. Cost-benefit research database on high performance building design guidelines associated with productivity, health and environmental benefits.

31 Kats, Greg. *The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force*, October 2003. See also many other reports by Kats.

32 Persram, Sonja, Lucuik, Mark & Larsson, Nils. *Marketing Green Buildings to Owners of Leased Properties*, Canada Green Building Council, 2007

33 Persram, Sonja, Larsson, Nils & Lucuik, Mark. *Marketing Green Buildings to Tenants of Leased Properties*, Canada Green Building Council, 2007

Building Challenge, are not well understood among corporations. The growing body of research demonstrating greater value and performance of green buildings, and the quantification of negative impacts associated with conventional building practices, would be expected to facilitate a shift in thinking from concerns about increased first costs to recognition of the long-term savings and benefits.

The appraisal process currently presents significant barriers for high performance green building projects. Appraisers are not yet required to take into consideration green measures such as energy efficiency, compared to conventional buildings, when evaluating property. Commercial properties' present value of savings from green building measures can be accounted for in corporate financial statements to recognize higher net operating income and returns on investment. However, there are challenges to valuing assets based on cost and not on market value.[34] Further, no such inclusion of benefits exists in finance or appraisal regulations for residential properties.

Another challenge is that appraised values of green building measures are neither pervasive nor consistent. One U.S. appraiser reduced the value of a new green building because of its vegetated green roof, failing both to understand the added value of a building feature that reduces heating and cooling loads and provides a variety of other environmental benefits. Another appraiser was hired.

Informational barriers about building energy performance help explain the lack of investment in residential energy efficiency measures. For instance, the value of a house should reflect its energy efficiency – but tends not to do so when "potential buyers have difficulty in recognizing and evaluating the potential energy savings."[35] Mandatory energy labeling can help overcome this market knowledge gap.[36] The Brookings Institution recommends that the Real Estate Settlement Procedures Act (RESPA), which protects homebuyers in case of unforeseen risks, *"be expanded to include the unseen costs related to energy. Sellers should be required to disclose energy costs for several years before the sale. RESPA should also require the uniform disclosure of energy-efficient investments or energy-efficient certifications previously awarded to the home".* [37]

Requiring that residential and commercial buildings be audited for energy performance upon sale or major renovation is a key regulation and market driver in the City of Berkeley, California.[38] Likewise, the European Union's Energy Performance of Buildings Directive mandates building energy performance evaluations when buildings are rented, sold or constructed.[39] In the Netherlands, building codes require building performance to be measured before a building can have a "standard" label applied.[40] Canada is in the process of developing a building energy label that will measure energy intensity in equivalent kWh/m2 which could be used in existing building evaluation systems like LEED® Canada and BOMA Go Green.[41]

34 Corps, Chris. "Background Paper 2c: Toward Sustainable Financing and Strong Markets for Green Building: Valuing Sustainability." Commission for Environmental Cooperation, 2008

35 Jaffe, Adam B., and Stavins, Robert N. "Energy Efficiency Investments and Public Policy." *The Energy Journal*, Vol. 15, No. 2, 1994, IAEE.

36 Wilson, A., Atlee, J. and Webber, D./Halsall Associates, PAPER 3b: Institutional Efforts for Green Building Approaches in Canada and the United States, Commission for Environmental Cooperation, March 2008: http://www.cec.org/pubs_docs/documents/index.cfm?varlan=english&ID=2238 see also: http://www.cec.org/files/PDF/GBPaper3b_en.pdf

37 Marilyn A. Brown, Frank Southworth, and Andrea Sarzynski. "Shrinking the Carbon Footprint of Metropolitan America." Brookings Institution, May, 2008

38 City of Berkeley, California has mandated retrofit of energy conservation measures in residential and commercial energy, upon sale or major renovation: http://secure.nhanced.net/sites/site30/documents/Berkeley_Energy_Conserv_Ord.pdf

39 European Commission Directorate-General for Energy and Transport, Energy Performance of Buildings Directive (EPBD) Building Platform: http://www.buildingsplatform.org/cms/index.php?id=19

40 Martin Liefhebber, MRAIC to Sonja Persram upon discussions with the Netherlands delegation to Toronto, June 2008.

41 Natural Resources Canada, Office of Energy Efficiency, Energy Rating and Labelling System: http://oee.rncan.gc.ca/commercial/regulations-standards/labelling.cfm?attr=16

Other environmental, social and economic regulatory opportunities

While the impacts of energy use and the associated risks of climate change have been discussed at length in this report, it is not the only concern that needs to be included in regulations. Other environmental issues and social factors are equally as important and pose barriers where regulations fall short of adequately addressing them. Local, state, provincial and federal tax incentives can promote more sustainable development while helping support local economies. Where green building measures provide societal benefits that are not quantified, the monetized differentiation between green and conventional buildings is limited. New York City Battery Park City Authority dealt with this challenge by measuring their water and sewerage savings from their comprehensive water reuse program, earning customers a 25% discount on their water rates.[42] The economic benefits of water reuse extend beyond a reduction in demand for potable water supply and wastewater treatment, to a decreased demand for significant investment to build new water and wastewater infrastructure.

Instituting a regulated Renewable Portfolio Standard (RPS) can facilitate local economic development opportunities. An RPS is established by a government or utility whereby a set percentage of energy supply must come from renewables. Locally-owned projects (such as distributed generation or district systems) generate 25-200% greater economic value for the local community. Renewable energy and energy efficiency are typically discussed in terms of specific project costs and benefits. However, a U.S. DOE report from 1997, "Dollars from Sense: The Economic Benefits of Renewable Energy," describes the significant local economic benefits from renewable energy projects based on research showing that a majority of every dollar spent on conventional energy production immediately leaves the local economy. [43]

Passive measures, incorporated through an integrated design process that treats buildings as whole systems, can result in 75% or greater savings in energy use.[44] Additional passive design strategies include dematerialization—designing out the need for technological solutions, thereby eliminating equipment and reducing lifecycle impacts.[45] While there are a variety of federal and state incentives for both active and passive solar, few jurisdictions offer significant benefit to residential and commercial property owners who incorporate deeply integrated passive design strategies.[46] One reason suggested by architect Martin Liefhebber for the dearth of passive incentives has been the lack of commodification of passive measures, since there is minimal corporate benefit from applying them, and no advocating industry association.[47]

42 Ed Clerico of Alliance Environmental LLC, whose company has worked on many of the water reuse systems in New York City, noted that two of their Battery Park City initiatives have qualified for a water demand side management incentive rate structure from the city called the Comprehensive Water Reuse Incentive Program which provides 25% discounts on water services. Owners provide systems for onsite treatment and reuse of water resulting in at least 25% reductions in water consumption compared to conventional use. www.nyc.gov/html/dep/pdf/waterreuse.pdf

43 "Dollars From Sense: The Economic Benefits of Renewable Energy." September 1997, U.S. Department of Energy http://www.nrel.gov/docs/legosti/fy97/20505.pdf

44 Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino. 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, New York, NY, USA

45 PassivHaus Institut: http://www.passiv.de/English/PassiveH.HTM

46 "Incentives for Passive Solar, Database of State Incentives for Renewables and Efficiency (DSIRE)" http://www.dsireusa.org/library/includes/SeeAllTechno.cfm?techno=Passive_solar&CurrentPageID=2&Search=Technology&EE=1&RE=1

47 Liefhebber, Martin, MRAIC. Personal communication with Sonja Persram, 2007

IV. TIPPING POINT

This is a time of great change, crises and opportunity. Our ability to accurately perceive the full spectrum of risks we face and to craft appropriate responses that balance our current needs for health, safety and welfare with those of all who follow could not be more important. Current best practices in design, building and development and in the regulatory sphere do not come close to adequately responding to the urgency and seriousness of our situation.

Prevailing research shows we have reached a tipping point. Awareness of the value of green buildings today is widespread and exemplified by the growth of the U.S. and Canada Green Building Councils, the market penetration of LEED certified and registered projects, and the adoption of green building policies by federal, state, and local governments. The emergence of the Living Building Challenge as a standard to pull the market beyond current levels of mainstream green building further demonstrates this shift.

An increasing body of research shows the comparative benefits of green buildings over conventional ones. This research indicates that organizations, governments and portfolio managers not facilitating green building or addressing climate change for buildings within their purview, could be viewed as putting their own finances, operations, employees, directors, portfolios, investors, and the broader public at risk.

This new aspect of fiduciary responsibility is highly significant. It means money now spent on conventional buildings rather than on energy and water efficiency, improved indoor environmental quality, natural views and renewable energy could be seen as money at risk. There is now an expectation that regulators of, and portfolio operations in, all sectors related to the built environment should be increasingly likely to demonstrate preferences for green practices, and to support building and planning regulations to enable this preference.

We need vision and leadership to enable the creation of a comprehensive and integrated regulatory system capable of enabling an orderly transition to the post peak world we are rapidly approaching.

MODULE 3

ANALYSIS OF THE BARRIERS TO THE LIVING BUILDING CHALLENGE

It is important to note that specific barriers in building and development codes are rarely absolute. Most viable alternatives can eventually gain regulatory approval with the investment of sufficient time and resources – often at unrecoverable proponent expense.

ANALYSIS OF THE BARRIERS TO THE LIVING BUILDING CHALLENGE

I. OVERVIEW

Both systemic and specific barriers exist for building projects seeking to meet the goals of the Living Building Challenge. Barriers are embedded in public and private policies related to the built environment and include codes regulating building and development, energy and water-related utilities, insurance and reinsurance, finance and investment, tax policies, incentives, disincentives and subsidies. Some of these have direct impacts while others pose economic obstacles to project teams looking to achieve the overall performance goals and requirements of the Living Building Challenge.

Systemic regulatory barriers to Living Buildings, detailed in the preceding Context section, are mainly based in the paradigm—the beliefs, values, principles, and goals—that gives rise to regulations and regulatory systems. They also arise from the scope of authority and responsibility of regulatory agencies and organizations, as well as relationships (or lack thereof) between agencies, departments, jurisdictions, and levels of authority. Increasingly, they are the result of differing levels of recognition of the serious climate, resource, and ecosystem and human health risks now faced. These risks have yet to be fully internalized in regulatory systems, leading to seeming conflicts between sustainability goals and the narrower traditional range of regulatory responsibility. The results can be found both in regulatory inaction and in the hindrance of efforts to address these larger risks.

Specific barriers relate to the implementation, enforcement, content and interpretation of regulations, codes and standards, approval processes and sequences, as well as problems of organizational capacity and capability. The variability that exists in knowledge, judgment, attitude and, occasionally, integrity adds to the challenge. It is important to note that specific barriers in building and development codes are rarely absolute. Most viable alternatives can eventually gain regulatory approval with the investment of sufficient time and resources – often at unrecoverable proponent expense. Therefore, they become real and practical barriers given the schedule and budgetary constraints of most building projects.

The methodology employed in developing regulatory policies, codes, and standards can create barriers when the process does not adequately protect all interests, including the public interest. Living Building projects are required to achieve higher-than-normal goals across a wider-than-normal spectrum of performance. The Living Building Challenge could be viewed as surpassing "end-of-pipe" type regulatory solutions, aiming to eliminate the source of risks "by design," rather than focusing on minimizing risks from mainstream practices. There are examples of jurisdictions striving to operate with this philosophy, including the Seattle Department of Planning and Development, and the City of Aspen, Colorado, which have aligned their regulatory efforts with the goal of enabling the best outcomes, rather than focusing solely on preventing the worst.[48]

This report focuses primarily on barriers likely to be encountered by projects pursuing Living Building status and similar goals, though many will apply more widely to mainstream green projects as well. Since, in practice, most regulatory obstacles have both systemic and specific origins, the analysis that follows categorizes the barriers though often there is extensive overlap.

II. SYSTEMIC BARRIERS

Gaps and Conflicts in Goals, Scope and Standards

Regulations emerge from societal norms and standards for risk management. Regulations and regulatory agencies are, by nature, limited in scope, in comparison to the risks they are responsible for addressing. Consequently, the variety, complexity, and differing types of risk make it a continuous challenge to perceive them accurately and address them adequately.

In a comprehensive regulatory framework, all risks would be considered. In the fragmented framework that exists, however, projects are deemed "safe" because of where we have chosen to draw the boundaries around which risks are included and which are not. This act of exclusion is rarely intentional. Most often, it results from a failure to recognize risks beyond the usual scope of an agency's regulatory concern. And it may cause harm as an unintended consequences of risks that are allowed—typically in other places, timeframes, or systems. Actual risks rarely conform neatly to regulatory boundaries. Where they extend beyond established categories, typically they are not regulated. Examples include the failure of regulatory systems to address the contribution of the built environment to climate change, or the failure to address the toxicity of building materials that outgas chemicals such as formaldehyde. The scientific and public health communities often document serious and growing risks and bring them to the attention of regulators, but it can take years before there is sufficient acceptance of the risks to create a regulatory response.

Resistance to addressing new kinds of risks among regulators occurs for many reasons including lack of time, expertise or knowledge, regulatory scope, and fears about liability for actions taken or not taken. Regulatory agencies do not operate in a vacuum and are subject to the whole spectrum of outside influences. Additionally, those responsible for enforcing regulations are

48 Eisenberg, David, *Leading the Way: Building Departments as Community Resources for Better Building Practices*, Building Safety Journal, June 2003

usually not the people who created them: thus the ability to address risks, or authority to approve less harmful alternatives, may not be completely within the discretion of the regulators.

Risks can be so large that they become invisible to regulators and policy makers. An example is climate change and the failure to fully grasp the global energy situation, which has kept regulators from seeing the urgency of shifting all systems toward lower-energy and higher efficiency practices. The world has a finite supply of non-renewable energy sources and we are at or near peak production for these resources.[49] As supplies diminish, it becomes increasingly energy-intensive to extract and use the fuel that remains. It will take an enormous investment of energy to create a sustainable energy system yet the regulatory system has failed to recognize the enormity of this risk.

In a comprehensive regulatory framework, all risks would be considered. In the fragmented framework that exists, however, projects are deemed "safe" because of where we have chosen to draw the boundaries around which risks are included and which are not. This act of exclusion is rarely intentional. Most often, it results from a failure to recognize risks beyond the usual scope of an agency's regulatory concern. And it may cause harm as an unintended consequences of risks that are allowed—typically in other places, timeframes, or systems. Actual risks rarely conform neatly to regulatory boundaries. Where they extend beyond established categories, typically they are not regulated.

Greg Allen, Sustainable Strategist at HOK in Toronto, notes that dwindling supplies, the rising demand and competition for primary energy sources, and the attendant risks to society should drive regulation toward the lowest embodied and operating energy strategies in buildings, as well as toward renewables. He states that *"the transition to a sustainable energy system competes for energy to provide essential goods and services as well as to produce the non-renewable fuels and plants to deliver secondary energy supply. The viability of civilization will depend on how quickly we redirect investment into the infrastructure that can deliver end-use services at a high return on energy invested. Building codes should be guided by life-cycle analysis of embodied and operating energy to ensure resources are optimally applied. We must assume that the next generation will, by necessity, be relying exclusively on the renewable energy infrastructure availed by our efforts."*[50] Without understanding these risks, passive design and lowest energy building and development strategies will continue to lack the regulatory support they deserve.

Living Buildings must address a more comprehensive set of risks, and take responsibility for a broader set of impacts than the scope of authority of the individual regulatory agencies that govern them. Consequently, systems and designs used in these projects may cross jurisdictional and regulatory boundaries beyond the scope of concern, experience, and authority of the agencies that must approve them. Developing the institutional capacity to deal with projects seeking the goals of the Living Building Challenge should be a priority, particularly in larger jurisdictions.

A classic example of conflicting regulatory goals is in relation to the regulations governing water and wastewater services for buildings. Though this is beginning to change, in most places all water entering a building is required to be potable water (drinking water quality) regardless of its intended use, and once used must be treated as blackwater (raw sewage) regardless of the use. If there is an available sewer system, typically there is a legal requirement to connect to it, and if not, a requirement to install a water-based septic system. In most jurisdictions, toilet flushing using rainwater or greywater is prohibited. The result is that in most places there is a legal requirement to intentionally pollute drinking water with human excrement. Water pollution is clearly not a public good. The costs of dealing with this creation of legally polluted water include the creation of entire wastewater conveyance and treatment systems and reduced availability of clean, uncontaminated water. Yet, projects pursuing the Living Building Challenge prerequisite of net zero water often find their desired solutions in conflict with the whole set of regulations governing water and wastewater.

49 Pearce, Joshua M. "Thermodynamic limitations to nuclear energy deployment as a greenhouse gas mitigation technology." *Int. J. Nuclear Governance, Economy and Ecology*, Vol. 2, No. 1, 2008

50 Allen, Greg, P.Eng., Sustainable Strategist, HOK. Personal communication with Sonja Persram, August 13, 2008

... in most places all water entering a building is required to be potable water (drinking water quality) regardless of its intended use, and once used must be treated as blackwater (raw sewage) regardless of the use. If there is an available sewer system, typically there is a legal requirement to connect to it, and if not, a requirement to install a water-based septic system. In most jurisdictions, toilet flushing using rainwater or greywater is prohibited. The result is that in most places there is a legal requirement to intentionally pollute drinking water with human excrement.

Conflicts between the goals of different sections of building codes create problems. For example, fire and smoke control provisions may contradict low-energy and passive design goals such as natural ventilation and operable windows.

Conflicts also occur among sustainability goals. These include the objective of code and zoning ordinances to protect existing trees (for building cooling, as carbon sinks, heat island mitigation, natural views, human health and enhanced property value purposes) versus facilitating solar access on the property (for passive and active solar measures, daylight-enhanced productivity, and addressing food security).[51] Similarly, urban/wildland interface codes require "defensible space" around buildings, meaning no trees or other flammable vegetation close to the building, again in conflict with many of the above mentioned goals. Other regulations prohibit potential design solutions, such as placing solar panels on adjacent properties through mutual agreement of landowners. Similarly, sites constrained by size or soil conditions may not legally share rainwater or greywater resources with adjacent sites, even where such arrangements are acceptable to both landowners.

An exceptional compendium of barriers—along with many solutions—is found in the Rocky Mountain Land Use Institute's Draft Sustainable Community Development Code.[52] It catalogues conflicts between sustainable community goals and standards, and the goals of conventional land use planning, zoning and building regulations. They include densities, setbacks and height limitations, and prohibitions against front yard gardens and urban and suburban agriculture; wind and solar energy installations; on-site rainwater harvesting, storage, and reuse; and on-site greywater reuse.

Multi-Jurisdictional, Intra-Jurisdictional, and Inter-Agency Issues and Conflicts

At the most fundamental level, the separation of regulatory authority based on discipline (building, land use/zoning, environmental impact, public health, transportation, utilities, etc.) or jurisdiction rarely matches the complex and interrelated realities of the regulated activities and their risks. For example, the division of planning and the regulation of land use and building in most local governments results in fragmented regulation of activities and outcomes that cross many regulatory boundaries. This problem is sometimes easier to see once action has been taken to correct it. For example, according to Seattle Department of Planning and Development (DPD) Director Diane Sugimura, the merger of Seattle's planning, building and land use departments *"brought into view critical relationships between the city's goals for sustainability and issues of building and development connected to the Growth Management Act; the Comprehensive Plan; water, energy and infrastructure; and the whole concept of concentrating people in thriving urban centers where they are no longer dependent on cars. As a planner for many years before coming over to the building regulatory department for the past decade, it is clear that having these departments together lets us develop more effective and integrated solutions."* [53]

Regulatory issues that cross departmental, agency or jurisdictional boundaries can pose the most difficult challenges. They often involve water-related issues, zoning, transportation, stormwater management, and fire safety. For example, local jurisdictions may want to approve something prohibited by state codes or the reverse. Both Portland, Oregon and Chicago, Illinois have had to

51 Persram, Sonja. "Solar Access Issues." June 26, 2008, iGreenBuild.com

52 *Sustainable Community Development Code*, Rocky Mountain Land Use Institute, 2008 http://www.law.du.edu/index.php/rmlui/sustainable-community-development-code

53 Eisenberg, David. "Leading the Way: Building Departments as Community Resources for Better Building Practices" *Building Safety Journal*, June 2003

confront state plumbing codes that prevented them from approving non-water urinals. In other cases, more than one agency can have authority over the same or interrelated parts of a project with differing concerns, goals, standards or approval sequences.

Water laws in Colorado and Washington State give water rights to the state or holders of senior water rights, making site harvesting of rainwater illegal and possibly making the reuse of greywater illegal as well (although efforts are underway to address this). Where there are centralized water or wastewater utilities it is often a legal requirement to connect to them as a condition of building permit issuance, prohibiting small scale treatment facilities unless they are licensed as a utility. Further, regulations may prohibit creating a new utility where one is already operating, even when the existing utility is operating at or beyond capacity.

Interdependent systems operated by different jurisdictions with conflicting operational needs can create regulatory opposition to water conservation measures. For instance, a city-owned water utility's water conservation goals that encourage greywater reuse and ultra-low-flow fixtures may be opposed by the county-run wastewater utility because of concerns about insufficient flows to convey solids through their system.

Yet another example of inter-and intra-jurisdictional barriers is around the issue of construction waste diversion in one Canadian municipality. While the province's goal requires diverting commercial waste from landfill, the city focuses on residential waste diversion, and commercial waste is picked up by private companies and regulated provincially. There is no municipal commercial waste diversion program– although this sector comprises two-thirds of the waste stream. Because almost half of the city's budgeted municipal waste management revenue comes from tipping fees, and they are a significant funding source for residential waste diversion, the combined system is a disincentive to construction waste diversion. Developing revenue streams appropriate to sustainability goals and closed-loop waste management systems would help solve the problem.

Stormwater is often managed through a complex maze of regulatory authorities from the local to the federal level. Strategies aimed at minimizing the impact of stormwater runoff can run afoul of other regulations that don't allow green (vegetated) roofs, pervious pavement, or require that roof gutters connect to storm sewers. This is true even in some cities with combined stormwater and sewer systems where serious public health risks associated with overflows of the combined systems exist. Further, most infrastructure projects designed to separate sewer and stormwater systems are planned without regard for the enormous potential for downsizing these systems though the widespread application of distributed, site-based low impact development solutions such as bioretention cells, rainwater harvesting, green roofs, and reduced hardscapes.

A widely recognized but still persistent problem lies in the authority of state and local fire marshals over decisions related to street widths. They often require full emergency access for fire trucks and other emergency vehicles, insisting on paved roads wide enough for parking on both sides of the street and room for two fire trucks to pass each other or enough space for fire apparatus turnaround. In contrast, many jurisdictions have goals of minimizing hardscapes to mitigate stormwater runoff or using narrower streets for traffic calming purposes. Similarly, transportation departments may object to the use of pervious pavement or alternative street designs intended to minimize hardscapes because they diverge from the currently accepted standards. Zoning laws typically require more parking than sustainable land use and development practices recommend, particularly where there is access to public transportation. Reducing parking requirements can support urban densification while facilitating alternative modes of transportation.

Process Barriers: Lags, Sequence, and Time of Approvals and Appeals

Projects with high performance goals frequently experience delays from appeals and out-of-sequence approvals processes, especially where a number of agencies are involved in approvals. Variances and appeals can extend project durations by years, resulting in costs that may not be recoverable by the project team. Two Portland, Oregon projects pursuing water independence goals, for instance, required multiple regulatory consultations, permits and appeals. If key appeals had not been successful, the whole set of assumptions underlying the buildings' water, wastewater, water treatment and reuse, landscaping and associated systems would have been negated. A complete redesign would have been required of those systems and everything related to them, with the projects then resubmitted for approval. Few clients or design teams are willing or able to take such risks to enable needed change in the regulatory system.

The sequencing and timing of approvals can also present obstacles during permitting. Building permits usually must be secured prior to the issuance of demolition permits, both for existing building renovation and when new construction requires site demolition/deconstruction. Because it may take only a week to demolish a building (with all construction waste going to the landfill), but a month to deconstruct, salvage, sort, and store for onsite reuse or transport to appropriate reuse vendors, there often is not enough time once the building permit is issued for deconstruction to take place. Modifying the sequencing of demolition permits to allow for an earlier start of deconstruction would alleviate this issue and increase the incentive to divert valuable building materials from landfills.

Inconsistent Interpretation and Inadequate Enforcement

Insufficient state and local resources and inconsistent commitment and political will have created extreme variability in adoption and enforcement of codes, especially state energy codes. According to the U.S. DOE, in some states less than one full-time-equivalent employee is dedicated to enforcing the energy code. This lack of enforcement poses a legal quandary and represents a risk exposure for the regulators according to the U.S. DOE. "Local governments are not relieved of the legal responsibility to ensure that the home meets minimum energy standards,"[54] however local and state bodies lack the resources to achieve these legal standards. Consequently, enforcement responsibility often devolves from staff to voluntary programs: "Most states have energy efficiency standards in their regulations that give many of the nation's 44,000 local governments the authority to enforce the standards. However, finding the resources and political will to enforce them can be difficult. Some states and communities do not enforce a minimum mandatory energy code and rely instead on voluntary programs to achieve their energy efficiency goals."[55] The result is widespread and significant building underperformance.[56]

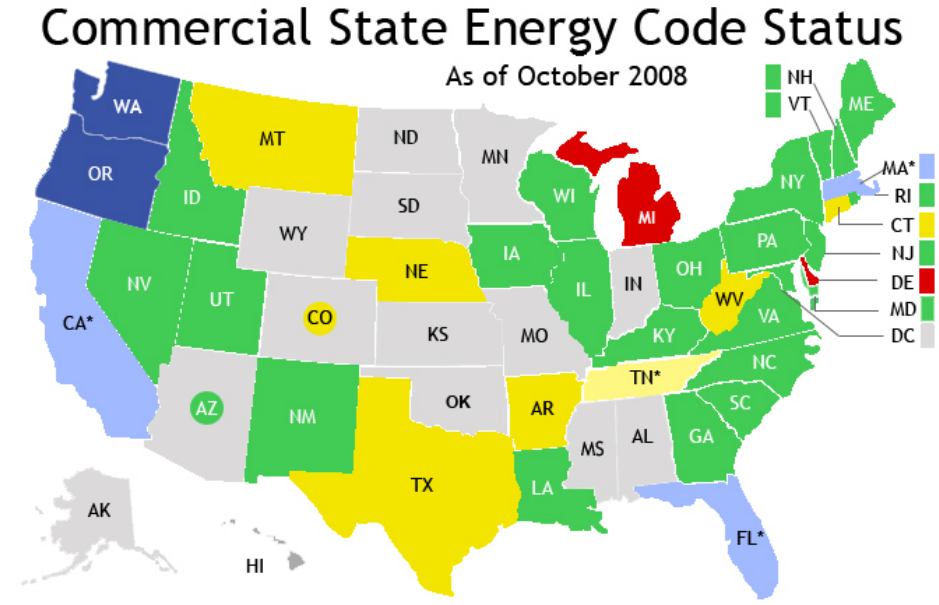
Lack of enforcement can also be a problem in jurisdictions where enforcement of energy codes is left to the judgment of individual plan reviewers and inspectors, or to individual jurisdictions without statewide requirements. In jurisdictions with adopted energy codes, the building official may not see energy conservation as tied to life safety issues, and therefore not enforce energy code requirements during plan review or inspection.

The administrative provisions of codes provide building officials with invaluable authority and legal protection to use their judgment to interpret the codes. This flexibility can also lead to differing enforcement of codes across jurisdictions. Building officials may be unaware of rulings or changes

54 *Voluntary Rating Systems*, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/voluntary_rating_systems.cfm accessed June 21, 2008

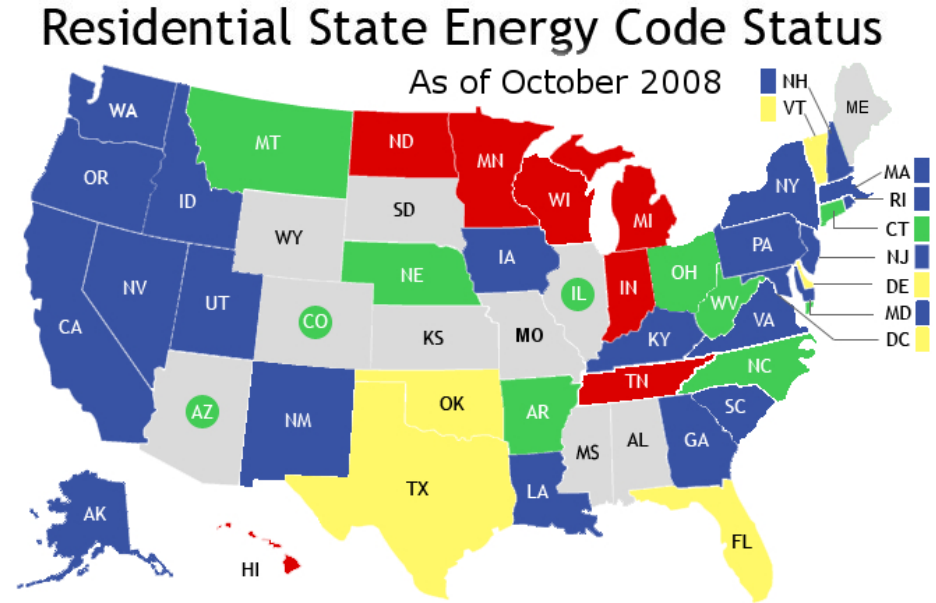
55 *Energy Codes and Standards*, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/codes_standards.cfm accessed June 21, 2008.

56 According to Peter Garforth, Principal of Garforth International LLC: based on the average of all new construction, approximately 20% of new buildings in the United States are underperforming by 20% or more, compared to energy codes requirements. Source: presentation at the NRCAN OEE-organized Building Energy Labelling Forum, December 1, 2006. Personal communication cited in Persram, Sonja, USA, in International Sustainable Building Policy Initiatives, Nils Larsson, lead author, Canada Mortgage and Housing Corporation, 2006.



- Effective code meets or exceeds ASHRAE 90.1-2007 or equivalent
- Meets 2006 IECC / ASHRAE 90.1-2004 or equivalent
- Meets 2003 IECC / ASHRAE 90.1-2001 or equivalent
- Meets 2001 IECC / ASHRAE 90.1-1999 or equivalent (meets EPCA)
- Precedes ASHRAE 90.1-1999 or no statewide code
- Significant adoptions in jurisdictions
- * Lighter color indicates code has been adopted but not yet effective

Source:
Building Codes Assistance Project
www.bcap-energy.org



- Adopted code meets or exceeds 2006 IECC or equivalent
- Meets 2003 IECC or equivalent
- Meets 1998-2001 IECC or equivalent (meets EPCA)
- Precedes 1998 IECC or equivalent (does not meet EPCA)
- No statewide code
- New code soon to be effective
- Significant adoptions in jurisdictions

Source:
Building Codes Assistance Project
www.bcap-energy.org

"... [E]ach time the [energy] codes are updated it takes years before the upgrades are adopted by states and before the full knowledge of those changes reaches the enforcement officials."

that set new precedents for approval of a green design strategy, such as a case in California where a local official was unaware of the letter from the State Architect re-interpreting the Uniform Plumbing Code to allow non-water urinals.

An underlying barrier is that inadequate public recognition of the value of regulatory services undermines adequate funding for them. Building codes do silent good, typically only getting public attention when something goes wrong. Everyone recognizes that firefighters save lives. Few recognize that building officials save far more lives including those of firefighters. This challenge is illustrated by a government official's confidential report that municipal funds allocated for code enforcement were directed instead toward other activities more visible to taxpayers.

Lack of Information, Education, Training and Advocacy

There is a widespread need for better information, training and staff development to keep current with changes in regulations and policies and especially with innovation and emerging knowledge about risks and building performance research. The complexity and evolving nature of energy codes, renewable energy systems, alternative water or wastewater treatment systems, and other nonconventional approaches are a challenge for building departments. Gaining approval or passing inspections is more difficult when officials are not appropriately educated or trained. The U.S. DOE has noted that knowledge gaps exist within regulatory agencies responsible for plan review and enforcement: *"... [E]ach time the [energy] codes are updated it takes years before the upgrades are adopted by states and before the full knowledge of those changes reaches the enforcement officials.*[57] *"Surveys conducted over the years indicate that mandatory energy codes are often ignored because they are too complex and difficult to understand."*[58]

Lack of familiarity with alternative building systems can lead to officials insisting on inappropriate changes, details or other requirements. For instance, in Vancouver, BC, in response to completely unrelated moisture problems, the Homeowner Protection Office[59] began requiring all residential green roofs to be covered by homeowner warranty policies, while the insurers, unfamiliar with their history of successful use, have been reluctant to issue such policies.

Often lack of specific knowledge of alternative systems results in requiring a superfluous conventional backup system, such as requiring a backup septic system to be built in order to approve a composting toilet, as in the case of the EcoSense project in British Columbia.[60] Jurisdictions may also lack trained staff to model or analyze engineered designs. The lack of dependable and accessible sources of information contributes to this problem.

Lack of Representation

Challenges to sustainable development projects originate in both the historic lack of focus on sustainability in the regulatory community, and in the lack of participation by green building practitioners in regulatory processes. While architecture, engineering and contractor firms may have staff dedicated to facilitating regulatory approval of their own green projects, with few exceptions there is little support for external advocacy for green building policies. In the current economic climate, there likely will be even less support for such "overhead" costs. This is particularly problematic for advocacy on behalf of green strategies such as passive measures or other non-commodified innovation.

57 *Energy Codes and Standards*, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/codes_standards.cfm

58 *Voluntary Rating Systems*, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/voluntary_rating_systems.cfm

59 Homeowner Protection Office, British Columbia: http://www.hpo.bc.ca/

60 Baird, Gord & Ann. Personal communication with David Eisenberg, June 2008

It is vital that the U.S. Green Building Council and the Canada Green Building Council focus on ensuring green interests are at the table during all regulatory and code development processes. Although the American Institute of Architects and the USGBC have code committees, the green building movement is not yet engaged in these processes in the same way industry trade associations are, and could provide more comprehensive representation of all segments of the public interest in regulatory processes.

Attitudinal Issues

Few barriers are more difficult to overcome than attitudinal ones. Seeking to understand the basis for attitudinal objections is a starting point, but attitudes are commonly based in experience or some form of prejudice. Therefore, a rational argument may not be sufficient. In these instances, project teams should seek out the basis of the opinion underlying the objection, such as underlying goals and motivations of the person and agency involved. The most likely path to a successful outcome is to demonstrate that the proposed design meets the goals of the regulations. A good approach in attitudinal conflicts is to propose multiple options and seek the regulator's opinions about all of them. This process will engage both parties in discovering underlying rationales and goals, rather than getting locked up around a single issue or solution (even if there is only one that is acceptable).

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III. SPECIFIC BARRIERS

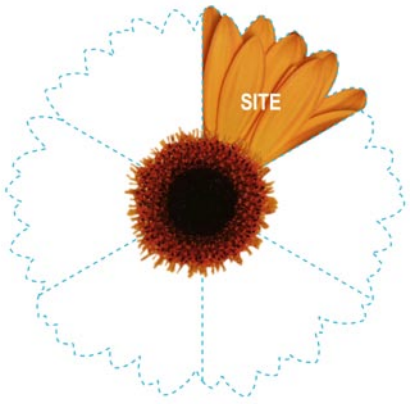
While the systemic barriers described above address obstacles Living Building Challenge projects might face within the regulatory system, specific barriers can also arise from across the spectrum of approvals required for building projects, including:

- the full range of building, development and land use codes and standards;
- local government general, specific and comprehensive plans;
- regulations related to watersheds, wetlands, open space and habitat conservation;
- transportation;
- water, stormwater, and wastewater;
- public health;
- public and private utilities;
- private sector policies in the realms of insurance and finance;
- restrictive covenants;
- and other laws and ordinances related to the built environment and its impacts.

In practice, these types of obstacles are often a complex mix of issues rather than a single issue or type. While each building project is unique and the nature of the barriers that exist will vary greatly, this section focuses primarily on those barriers that are most likely to be encountered by project teams pursuing the Living Building Challenge.

Technical Barriers in Existing Regulations and Utility Structures

Site



The continued outward spread of development and sprawl threatens the wild places that remain in the U.S. and Canada. This outward growth increases transportation impacts and associated pollution, while also increasing the negative pressure on ecologically sensitive areas undisturbed by development. The Living Building Challenge prerequisites that address site issues prohibit development on or near ecological sensitive areas and on greenfield sites. Because the requirements of the Living Building Challenge typically call for site selection and protection above and beyond minimum code requirements, they tend to highlight several concerns around existing zoning and development codes.

While some jurisdictions have stringent regulations on where development can take place, many lack comprehensive policies for limiting sprawl and protecting environmentally sensitive areas such as shorelines, old growth forests, prairies, wetlands, and other water bodies. Additionally, scientists are predicting increasing uncertainty about flooding and other conditions arising from anthropogenic climate change.[61] [62] Thus flood plains based on 100-year and 200-year levels can no longer be relied on – given some regions are now more drought-ridden or drenched than previously calculated. This impacts all aspects of planning and zoning and building in areas previously thought safe. It also impacts insurance and property valuation. This issue is likely to

61 Natural Resources Canada, *Climate Change Impacts and Adaptation*: http://www.adaptation.nrcan.gc.ca/

62 Milly et al. *Science Magazine*, February 6, 2008, http://www.gfdl.noaa.gov/reference/bibliography/2008/pcm0801.pdf

affect municipalities' responsibility for allowing development on floodplains. Catastrophic climate modeling could identify areas of higher risk as measures of disaster prevention not just disaster planning.[63] [64]

Redevelopment of greyfields and brownfields presents an obvious demonstration that building projects have the potential to heal already damaged landscapes and minimize impact from new development. Although challenges exist related to building on previously developed sites, few of these challenges are unique to Living Building projects. The financial cost of cleanup or remediation of a brownfield site, concerns about occupant exposure to contaminated soil or water, and ground source heat pumps are a few examples. However, most jurisdictions today are committed to seeing these sites renewed and restored to economically and socially productive use. Thus there is often motivation for jurisdictions to assist in overcoming regulatory barriers, as well as providing incentives to enable such projects.

Living Buildings seek independence from municipal or privately-owned utilities that often require connection as a conditional of code compliance. Additionally, setback requirements on the property particularly on urban sites may offer limited room for onsite stormwater and greywater management systems as required by the Living Building Challenge net zero water prerequisites.

Many older regions in Canada and the U.S. with combined sewer and stormwater systems subject to overflows in storm events would benefit from infill development that remained off-services without sewer connections. Yet even where the goals of net zero water would help alleviate water and sewer infrastructure challenges for densification, the process for approvals can be problematic. An example is the Canada Mortgage & Housing Corporation's award-winning Healthy Houses that were built in 1996 in Toronto located in alleyways without water or sewer connections. Architect Martin Liefhebber of Breathe Architects noted that while there are 14,000 suitable alley properties (i.e. garages and parking spaces) that could be redeveloped in Toronto (at a services/sewer savings of $200,000 per property)[65], approvals would be required each time to sever each garage, and obtain an exception to the requirements for garages, water and sewer services. Notes Liefhebber, *"Why do we have cars in garages when we have people sleeping on the streets?"*[66]

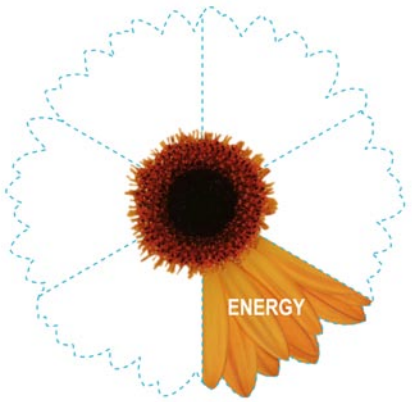
63 Persram, Sonja. Personal communication with Tony Gale, chair of USGBC Social Equity Task Force, April 2008.

64 *U.S. Water News Online*, Flood plains changing in fast-growing Georgia counties, July 2005: http://www.uswaternews.com/archives/arcpolicy/5flooplai7.html

65 Liefhebber, Martin. Personal communication with Sonja Persram April 2008 about unpublished research report (1997)

66 Persram, Sonja. "Urban Change Requires Vision" *Toronto Star*, February 2004

Energy



The majority of energy generated today is from unsustainable sources including coal, gas, oil and nuclear energy. The effects of these energy sources on regional and planetary health are becoming more and more evident, with climate change signaling the most worrisome environmental impact globally. The intent of the Living Building Challenge's net zero energy prerequisite is to encourage a safe, reliable decentralized power grid relying completely on renewable energy powering highly efficient buildings.

Historically, energy regulation has demonstrated a strong preference for centralized supply systems. A recent Assessment Report by the Intergovernmental Panel on Climate Change asserts: "The problem of 'lock-in' by existing technologies and the economic, political, regulatory, and social systems that support them were seen as major barriers to the introduction of low-emission technologies in all types of economies. This has not changed." [67] This problem is manifest in several ways. First, there is a widely held belief that base and peak loads can only be met through non-renewable centralized plants. This has biased investment and infrastructure towards centralization regardless of contrary evidence of renewables' benefits and capacity for addressing these loads, including:

- Adequate interconnection and storage allows renewables to supply reliable[68] base load and to be dispatchable (that is, they can be switched on and off – which enables their use to address peak loads).[69]
- Comparisons of relative costs and benefits give renewables an advantage over non-renewables.[70] [71] The factors compared include: societal health and related indirect costs,[72] [73] [74]

67 R.E.H. Sims, R.N. Schock, A. Adegbululgbe, J. Fenhann, I. Konstantinaviciute, W. Moomaw, H.B. Nimir, B. Schlamadinger, J. Torres-Martínez, C. Turner, Y. Uchiyama, S.J.V. Vuori, N. Wamukonya, X. Zhang. 2007: Energy supply. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

68 Cristina L. Archer. "Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms," February 2007, Department of Civil and Environmental Engineering, Stanford University

69 "The myth of renewable energy's unreliability has been debunked both by theory and by practical experience." Source: Lovins, Amory B., Sheikh, Imran and Markevich, Alex, Forget Nuclear, Rocky Mountain Institute newsletter Spring 2008, Volume xxiv #1: http://www.rmi.org/images/PDFs/Newsletter/NLRMIspring08.pdf

70 Mazria, Edward and Kershner, Kristina. "The 2030 Blueprint: Solving Climate Change Saves Billions" *Architecture 2030*, April 7, 2008: http://www.architecture2030.org/

71 Lovins, Amory, Datta, E.Kyle, Feiler, Thomas, Lehmann, Andre, Rabago, Karl R., Swisher, Joel N., and Wicker, Ken. *Small is Profitable, Part Two: Benefits of Distributed Resources*, Rocky Mountain Institute, 2003, http://www.smallisprofitable.org/pdfs/SIP_PartTwoExcerpt.pdf

72 Conrad G. Schneider. *Dirty Air, Dirty Power* (Washington, DC: Clear the Air, June 2004), based on Abt Associates Inc., et al., "Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios" (Boston: June 2004), cited in Brown, Lester R., U.S. Moving Toward Ban on New Coal-Fired Power Plants, February 14, 2008.

73 Ontario Medical Association, "The Illness Costs of Air Pollution: 2005-2026 Health and Economic Damage Estimate," http://www.oma.org/Health/smog/report/ICAP2005_Report.pdf June 2005

74 DSS Management Consultants and RWDI Air Inc. "Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation," Ontario Ministry of Energy, April, 2005 http://www.energy.gov.on.ca/english/pdf/electricity/coal_cost_benefit_analysis_april2005.pdf http://www.oma.org/Health/smog/report/icap05b.asp

risks,[75 76 77 78] CO2 emissions reductions,[79 80] viable alternative strategies,[81 82 83] the relative local job creation potential compared to the potential economic stimulus of energy efficiency retrofits[84] and renewables[85 86 87] and their associated energy efficiency job growth potential for factory workers, builders, operations and maintenance personnel.[88]

Second, centralized systems typically have priority access to the grid. This is in contrast to Germany, where renewable sources of energy were given first priority, both shifting the investment risk balance away from non-renewables toward renewable sources and guaranteeing that there will always be the highest percentage of renewable energy on the grid that is available.[89 90] In the Province of Ontario's recently tabled omnibus Green Energy and Green Economy Act, plans are underway to give priority grid access to renewables.[91]

75 Canadian Renewable Energy Alliance (CANREA), "Distributed Generation in Canada: Maximizing the benefits of renewable resources," August 2006, http://www.canrea.ca/pdf/CanREADGpaper.pdf

76 "France's Nuclear Summer" (2003, August 14). *The Sydney Morning Herald*. Retrieved from http://www.smh.com.au/articles/2003/08/13/1060588464148.html cited in CANREA, op. cit.

77 Tresilian, D. (2003, August 21). "Heat wave ripples hit France." *Al-Ahram Weekly*. 652. http://weekly.ahram.org.eg/2003/652/in8.htm in CANREA, op. cit.

78 R.E.H. Sims, R.N. Schock, A. Adegbululgbe, J. Fenhann, I. Konstantinaviciute, W. Moomaw, H.B. Nimir, B. Schlamadinger, J. Torres-Martínez, C. Turner, Y. Uchiyama, S.J.V. Vuori, N. Wamukonya, X. Zhang. 2007: Energy supply. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter4.pdf

79 Sovacoo, Benjamin K.. "Valuing the greenhouse gas emissions from nuclear power: A critical survey," *Energy Policy 36* (2008) 2940– 2953, www.elsevier.com/locate/enpol. The paper highlights some lifecycle estimates comparing electricity generators in terms of grams of carbon dioxide emitted per kilowatt hour (gCO2e/kWh):

Offshore wind	9 gCO_2e/kWh;
Onshore wind	10 gCO_2e/kWh;
Solar thermal via parabolic trough	13 gCO_2e/kWh;
Solar PV with polycrystalline silicone	32 gCO_2e/kWh;
Various nuclear reactor types	66 gCO_2e/kWh;
Coal with scrubbing	960 gCO_2e/kWh.

This raises questions about when a nuclear power plant would begin to have a net carbon benefit, given the large carbon footprint that must be overcome during operational life and the length of time to construct and bring a nuclear plant online.

80 Mazria, Edward and Kershner, Kristina. "The 2030 Blueprint: Solving Climate Change Saves Billions," *Architecture 2030*, April 7, 2008: http://www.architecture2030.org/

81 Lovins, Amory B., Sheikh, Imran and Markevich, Alex. "Forget Nuclear," *Rocky Mountain Institute newsletter* Spring 2008, Volume xxiv #1: http://www.rmi.org/images/PDFs/Newsletter/NLRMIspring08.pdf

82 Conservation and demand management programs plus addressing residual base load via wind/solar/biomass renewable energy, microturbine and industrial cogeneration, waste heat recycling, storage and smart grid technologies, hydro (including imports) and efficient deployment policies can supply the province's base load needs (reducing peaks also), conditional on a reliable continuous power supply being delivered via both variable and dispatchable sources. (Dispatchability allows for power to be switched on and off as required, and requires reliability.) Source: Peters, Roger and Burda, Cherise. "The Basics on Base Load," Pembina Institute September 2007: http://re.pembina.org/pub/1530

83 Lovins, Amory, Datta, E.Kyle, Feiler, Thomas, Lehmann, Andre, Rabago, Karl R., Swisher, Joel N., and Wicker, Ken, op.cit. http://www.smallisprofitable.org/pdfs/SIP_PartTwoExcerpt.pdf

84 Mazria, Edward and Kershner, Kristina, op. cit.

85 *Dollars From Sense: The Economic Benefits of Renewable Energy*, September 1997, U.S. Department of Energy http://www.nrel.gov/docs/legosti/fy97/20505.pdf

86 Europa reports: "Renewable energy in the EU has a turnover of €30 billion, providing approximately 350 000 jobs. Employment opportunities are vast, ranging from high-tech manufacturing of photovoltaic components to maintenance jobs at wind power plants or in the agricultural sector producing biomass." Europa Press Release: Memo on the Renewable Energy and Climate Change Package, January 23, 2008 http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/33

87 Germany's renewables initiatives – in addition to contributing toward energy security - have also contributed to economic benefit by 'generating' 214,000 jobs. German Federal Ministry of Economics and Technology website: http://www.german-renewable-energy.com/Renewables/Navigation/Englisch/root.html accessed June 2, 2008

88 Efficiency creates 21.5 jobs for each investment of $1 million http://apolloalliance.org/pickmanfeedback.php

89 German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, *The Renewable Energy Sources Act*, http://www.bmu.de/english/renewable_energy/doc/6465.php

90 Mandel, Jenny. "1. Renewables: Germans struggle to resolve new sources' conflicts with electricity grid," *ClimateWire*, May 28, 2008, Environment and Energy Publishing, http://www.eenews.net/public/climatewire/2008/05/28/1

91 http://www.greenenergyact.ca/

Third, variability of regulations and obstacles to onsite energy systems unfairly favor centralized systems. Building codes, setbacks and height limitations impact the ability to install onsite renewable energy systems. For instance, of the 25,000 zoning districts in the U.S., relatively few allow wind turbines[92] and provide for solar access rights. Zoning laws impact where turbines can be erected, since many ordinances prevent structures higher than 35 feet. The American Wind Energy Association has developed a model zoning ordinance for small scale wind turbines that can be applied to all districts.[93]

Fourth, the Inter-Governmental Panel on Climate Change identifies lack of adequate financial support as a key barrier to implementation of low-carbon energy sources.[94] For example, renewables often are subject to high hurdle rates (the required internal rate of return that an organization defines as needed to invest in a measure given perceived risk levels and informational barriers). Lowering hurdle rates, regulating a Renewable Portfolio Standard and enabling Feed-In Tariffs and Production Incentives would help address these barriers.

Some utility regulations also interfere with cascading uses of energy as reported by Paul Eisenberg of Suncadia.[95] He notes that the potential of combined heat and power (CHP) is wasted as long as utility regulation impedes distributed generation and district and site-sharing of surplus heating and cooling. This also minimizes potential for scale-jumping since current regulations prevent sharing waste heat, and other energy cascading measures, across property boundaries. Eisenberg identifies additional challenges: *"fundamental regulatory changes could allow buildings not in campuses, and under separate ownership to link such systems together in a network. Thus an urban grocery store could sell its surplus heat to adjacent condominiums. (However), current utility regulations would deem the grocery store to be acting as a utility company and prevent this from happening, under the regulatory intent of protecting consumers from unreasonable or unequal energy rates… (these) are all techniques with huge potential to reduce carbon footprint, but need to be implemented on the broadest, not the most isolated scale possible."*

Passive and dematerialization measures around energy such as low tech solutions, those with low embodied energy, and non-commodified systems are in the public interest yet receive little recognition in regulatory deliberations and frequently have no association, industry advocate, financial agency backing or support.[96] As such, they are "stranded interests." In fact, neither nature nor future generations have legal standing at the regulatory table as well. Consequently, these interests are often ignored because there is reliable advocacy for private interest without regard for public interest, and little advocacy for public interest that is independent of private interests. Yet, such measures have the potential to drive down energy consumption dramatically[97], thereby making net zero energy goals feasible for Living Buildings to achieve.

92 Green, J, and Sagrillo, M. "Zoning for Distributed Wind Power: Breaking Down the Barriers," presentation for WindPower 2005, May 15-18, 2005, National Renewable Energy Laboratory, www.nrel.gov/docs/fy05osti/38167.pdf

93 American Wind Energy Association, Small wind, AWEA Model Zoning Ordinance: http://www.awea.org/smallwind/documents/modelzo.html

94 IPCC, Climate Change 2001: Working Group III: Mitigation, Energy Supply http://www.ipcc.ch/ipccreports/tar/wg3/213.htm

95 Eisenberg, Paul, of Suncadia, Cle Elum, Washington. Personal communication with David Eisenberg, July 14, 2008

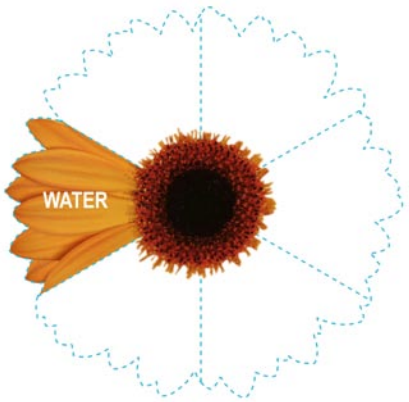
96 Liefhebber, Martin, MRAIC. Personal communication with Sonja Persram, 2007.

97 The comparative advantage of passive measures is evident from data provided by Peter Garforth to Sonja Persram, 2006 (see citation page 40). He reports that in the European Union, passive homes considerably outperform U.S. and low-energy EU residences on energy consumption. As well, emerging low-energy commercial/institutional buildings also outperform comparable U.S. buildings:

Homes:
Average U.S. home: up to 500 kWhe/m2/yr
New U.S. home: 200 to 350 kWhe/m2/yr
New EU low-energy homes: 80 to 110 kWhe/m2/yr
EU Net Zero/Passive homes: 40 and 70 kWhe/m2/yr

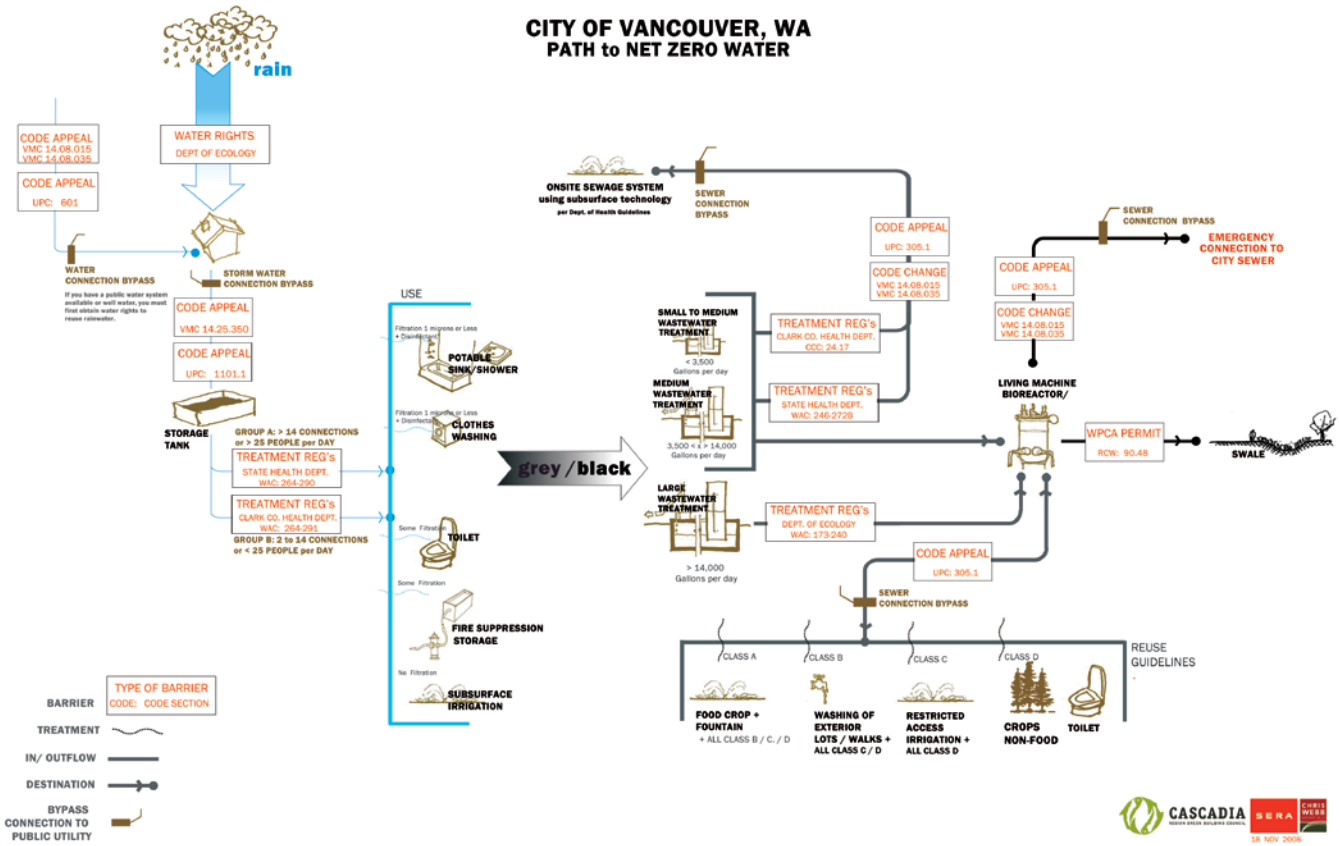
Commercial/Institutional Buildings:
Average U.S. building: up to 500 kWhe/m2/yr
New U.S. buildings: 200 to 500 kWhe/m2/yr
EU Emerging low-energy: 45 to 120 kWhe/m2/yr
New EU/California buildings: 150 to 250 kWhe/m2/yr, comparable to Ontario's new energy code

Water



Living Building Challenge projects must source 100% of occupants' water use from captured precipitation or closed-loop water systems, while also managing 100% of stormwater and building water discharge onsite. The most complex regulatory barriers encountered by projects pursuing Living Building status regulate the use of water supply and discharge. Part of the challenge is in the fact that water falls under the purview of multiple regulations, jurisdictions and agencies. Water and wastewater systems must conform to applicable plumbing codes, as well as to the regulations of state and local health departments, departments of environmental quality, stormwater management, reclaimed water, wastewater, wetlands, possibly the Corps of Engineers, and environmental protection agencies. There may also be state water rights laws and other state or local laws or regulations governing water reuse, greywater, rainwater harvesting, and water efficient fixtures and appliances.

The goal of creating projects that meet their own water supply and discharge needs onsite creates unusual challenges for the designers as well as the regulators. Those challenges start with the mainstream water paradigm: all water entering a building is required to be drinking water quality, regardless of its intended use, and all water once used, regardless of the use, is sewage and must be disposed of as such. Meeting net zero water criteria drives a set of design strategies very similar to those for energy. Maximizing efficiency is the most cost effective starting point, reducing volume of water that will need to be collected, treated, used, reused and eventually discharged in some manner onsite. Designers must assess the limitations of the actual site conditions and the projected available onsite supply to differentiate among water qualities and closely match the



The diagram above attempts to graphically portray the level of complexity for building projects within the City of Vancouver, WA, to gain approval for net zero water design strategies. Each box on the diagram represents a code variance or appeal required and documents the number of agencies involved at the city, county, and state levels. In most jurisdictions, projects seeking to decentralize water and wastewater systems to the site or district-level scale will most likely encounter similar challenges during regulatory approval.

quality with the use. This is a good basis for rethinking how best to manage water as a valuable resource and begin to address emerging water-related issues of supply and demand, quality, cost, and treatment.

The requirement for onsite water management in Living Building projects contrasts with the historic preference for centralized utilities. Enormous public wealth continues to be invested in centralized systems for both supply and treatment because centralized infrastructure and associated control and maintenance capabilities have been assumed to be the only cost-effective, viable solution. However, existing systems now face growing concerns about their ability to meet both current and future supply, quality, maintenance and public health needs, and to address their vulnerability to catastrophic failure or terrorism.

There have been significant challenges to adding appropriate decentralized alternatives into the mix, even where they can supplement inadequacies in centralized systems, and address supply and demand in a more integrated fashion. As with energy, this is not an "either-or" situation since society will increasingly need both centralized and decentralized systems in the future. A key barrier to the transition to more distributed systems lies in the operational levels of demand and delivery required for functionality and economic viability of centralized systems. These should not be allowed to delay or deny appropriate implementation of decentralized systems. Accurate and comprehensive comparative data on the relative water quality and water- and energy-efficiency of centralized and distributed systems is needed to help facilitate the transition. The need for monitoring and maintenance, which has been treated as a key reason for denying innovations, can create new services and related jobs in the private and public sector, with appropriate fees, training, certification, and reporting protocols for monitoring and maintaining distributed systems.

Water shortages in many regions have driven the development and successful implementation of laws and codes in Australia and several states in the U.S., yet many jurisdictions continue to oppose rainwater harvesting and greywater reuse. Additionally, even in areas with water shortages, regulatory resistance persists in many jurisdictions toward:

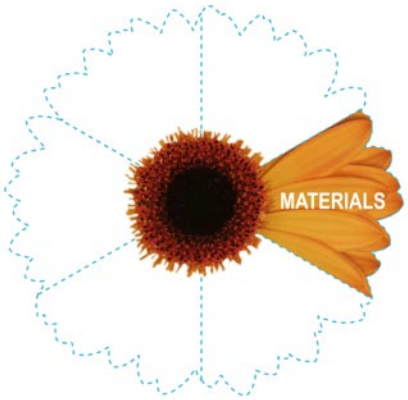
- onsite water sources other than from wells
- reuse of water onsite
- non-proprietary onsite treatment methods, even those with documented longstanding successful historic use, without the use of chemicals
- proprietary and nationally certified composting toilets

In 1998, in Los Angeles, California, the nonprofit group TreePeople simulated a 1500-year storm event by pumping 4000 gallons of water onto a suburban home in ten minutes.[98] In so doing, they demonstrated the feasibility of retrofitting homes with cisterns and earthworks to safely retain and productively use all that water on an urban site. That began a transformation in thinking about integrated management practices and the benefits of distributed systems, which are being demonstrated today in the Sun Valley Watershed in Los Angeles. These strategies are capable of replacing the community's "annual billion-dollar burden of separate infrastructure systems and needs"[99] while preventing stormwater pollution, street flooding, and increasing water security, significant water and energy savings, and creating thousands of new jobs.

98 "Rainwater as a Resource: A Report on Three Sites Demonstrating Sustainable Stormwater Management" http://www.treepeople.org/vfp.dll?OakTree~getPage~&PNPK=207

99 Kipnis, Andy, excerpted from: *Water Harvesting for Drylands and Beyond: Volume Two, Water Harvesting Earthworks*, by Brad Lancaster, 2008, http://www.harvestingrainwater.com

Materials



> *"We can no longer rely solely on the industrialized materials and building systems now in use given the enormity of their lifecycle impacts, embodied energy, and damage to the global climate. It is now critical that we invest in creating high performance, low-impact alternatives, including many traditional lower-tech building materials and systems. The utilization of local and minimally processed materials will be increasingly important as we develop a restoration economy for the 21st century."* [100]
>
> - Bob Berkebile, FAIA, BNIM Architects

Building projects seeking to achieve the Living Building Challenge are restricted from using materials that contain any of the "red list" of chemicals, commonly found in building materials, which pose serious risks to human and ecological health. In addition, these projects are required to obtain all materials and services from geographically local or regional sources, and to divert virtually all construction and demolition waste materials from disposal. Consequently, Living Buildings favor the use of natural and local building materials, low-energy and passive design strategies, and non-toxic alternatives to conventional building materials.

Living Building Challenge Red List Materials and Chemicals:
• Cadmium
• Chlorinated Polyethylene and Chlorosulfonated Polyethlene
• Chlorofluorocarbons (CFCs)
• Chloroprene (Neoprene)
• Formaldehyde (added)
• Halogenated Flame Retardants
• Hydrochlorofluorocarbons (HCFCs)
• Lead
• Mercury
• Petrochemical Fertilizers and Pesticides
• Phthalates
• Polyvinyl Chloride (PVC)
• Wood treatments containing Creosote, Arsenic or Pentachlorophenol

Historically, building regulations have seldom considered any aspects of building materials beyond their specific performance for their intended uses during their service life. Today, because of the massive volume of material and technological throughput and its even larger and wider-ranging impacts, that narrow focus no longer serves to safeguard public health and safety. There are many examples of systemic and specific failures of the regulatory system to address life cycle impacts of risks such as the ones articulated earlier in the Context section related to fire retardants and foam insulation.

Though not yet part of the building regulatory system, the concepts of life cycle analysis and lifecycle impact assessment are increasingly used in green building rating systems. The use of standard averaged metrics has limitations when it comes to dematerialization or very low-impact strategies. The benefits will only be revealed if the assessment intentionally focuses on discerning impacts related to:

100 Bob Berkebile, FAIA, BNIM Architects. Personal communication with David Eisenberg March 1, 2009

- site-based, local, or minimally processed materials
- assemblies that have been designed out of a building
- materials that utilize labor and skill rather than technology and resources to achieve design or performance criteria.

Gaps in addressing risks to human health and the environment that arise from the regulatory pattern of a focus on minimum standards also can contribute to substantial economic costs such as those for health care. The magnitude of these risks and costs could be expected to lead to a preference for precaution and a focus on scientific evidence. The Natural Step Principles (see sidebar) are useful in addressing the systemic risks overlooked by regulatory systems.[101] Alex Zimmerman and Charles Kibert have noted the value of the science-based principles of the Natural Step Framework whereby goals can be met only by dematerialization or substitution. The City of Madison, Wisconsin adopted The Natural Step and uses its framework "to inform decisions and foster interdepartmental collaboration." [102] The Precautionary Principle (see sidebar) is also an apt solution. The City of San Francisco is implementing the Precautionary Principle as a public policy to guide decisions for the city.[103]

The Natural Step (TNS) Level 2 Principles: [104]

1. Eliminate our contribution to systematic increases in concentrations of substances from the Earth's crust. This means substituting certain minerals that are scarce in nature with others that are more abundant, using all mined materials efficiently; and systematically reducing dependence on fossil fuels.
2. Eliminate our contribution to systematic increases in concentrations of substances produced by society. This means systematically substituting certain persistent and unnatural compounds with ones that are normally abundant or break down more easily in nature, and using all substances produced by society efficiently.
3. Eliminate our contribution to the systematic physical degradation of nature through over-harvesting, introductions and other forms of modification. This means drawing resources only from well-managed eco-systems, systematically pursuing the most productive and efficient use both of those resources and land, and exercising caution in all kinds of modification of nature.
4. Contribute as much as we can to the meeting of human needs in our society and worldwide, over and above all the substitution and dematerialization measures taken in meeting the first three objectives. This means using all of our resources efficiently, fairly and responsibly so that the needs of all people on whom we have an impact, and the future needs of people who are not yet born, stand the best chance of being met.

> *"When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. The process of applying the precautionary principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action."*
>
> -Wingspread Statement on the Precautionary Principle[105]

101 Robèrt et al. "Strategic sustainable development - selection, design and synergies of applied tools," *Journal of Cleaner Production* 10 (2002) 197–214, cited in Zimmerman et al, ibid.

102 Gruder, Sherrie. "Building a Green Capital City: The Natural Step to Madison's Sustainable Design and Energy Future," http://www4.uwm.edu/shwec/publications/cabinet/energy/Building%20a%20Green%20Capital%20City_%20The%20Natural%20Step%20to%20Madison's%20Sustainable%20Design%20and%20Energy%20Future.pdf

103 Precautionary Principle Policy for the City of San Francisco, California: http://www.sfenvironment.org/our_policies/overview.html?ssi=14

104 Robèrt, K.-H. *Natural Step: A Framework*, Pegasus Communications Inc., Waltham, Massachusetts, cited in Zimmerman et al., 2007

105 Wingspread Conference on the Precautionary Principle, January 26, 1998: http://www.sehn.org/wing.html

The Pharos Lens[106] is a framework for material evaluation that demonstrates the goal of the Living Building Challenge to create a paradigm shift, informing better materials choices and avoiding the use of materials with negative health or environmental profiles. Pharos is a work-in-progress with resulting 'gray areas' due to gaps in testing procotols and systems, and in knowledge. Thus some materials' components are not yet known (for example, proprietary products) or tested – meaning negative health and environmental effects may exist for these non-redlisted materials. It is well established that many man-made chemicals are present in the bodies of people tested worldwide, with health implications only partially understood for a small minority of these chemicals.[107 108 109]

Frequently, in response to concerns about the toxicity and the environmental footprint of mainstream materials or products which may sometimes be prescribed in codes, designers seek to specify simpler, safer and lower-impact materials. Without adequate supporting research that the alternatives will meet code requirements, they encounter costs and delays and often still cannot gain approval. With low-tech materials, research and testing reports from recognized laboratories typically do not exist although they often are required by building officials before approving their use.

Natural and local materials have low embodied energy, reducing climate and resource impacts of building and development. Their labor intensity makes them attractive to people with more time than money, and to people who desire beautiful, hand-crafted buildings. However the labor-intensive process combined with these materials' variability has made them problematic in mainstream building. The industrialized building paradigm of modern codes and standards, which values uniformity and the ability to mass-produce buildings has contributed to the preference for industrial materials over natural ones. Concerns about productivity, industrial efficiency and liability related to natural materials reinforces the preference. The vulnerability of the industrialized building system arising from its total reliance on the ability to affordably acquire, process and transport materials across the world, has been largely disregarded until now.

These new realities can be expected to shift demand toward preference for low-energy, local and minimally-processed solutions, and drive the need for research and development to optimize their use. A benefit and a challenge is that, ironically, given the biophilic and aesthetic appeal of natural materials and natural building, productivity of occupants may be enhanced even while productivity of the building process itself may slow.

Low-tech measures also score low on most green building rating systems because points are awarded for what is included in a project and not for what is designed out (and, typically, also out of the budget). By contrast, the Living Building Challenge prerequisites are not based on what is in the building, but on achieving high performance. Passive design strategies for heating, cooling and ventilation including those offered by some natural building materials, can result in avoided or substantially downsized HVAC systems. However, these benefits are lost when codes require full mechanical backup systems. The result is more equipment, environmental impact, and expense. For Living Building projects seeking to reach net zero energy performance, requiring mechanical systems with constant loads increases the difficulty of attaining those goals.

The variability of local and natural materials necessitates greater research, testing, evaluation and certification costs than with industrial materials, and there is no association, industry or funding

106 The Pharos Project: http://www.pharoslens.net

107 Lighthouse Sustainable Building Centre, "BC Green Building Code Background Research: Materials Emissions and Indoor Air Quality," October 2007: http://www.housing.gov.bc.ca/building/green/Lighthouse%20Research%20on%20Materials%20Emissions%20and%20Indoor%20Air%20Quality%20Oct%2022%2007.pdf

108 Human Toxome Project: http://www.bodyburden.org/

109 Environmental Defence, Toxic Nation Reports: http://www.toxicnation.ca/toxicnation-studies/reports

to support this research. However, variability is not always a limiting factor in regulatory and market acceptance. Wood is also a natural material with great variability: there are hundreds of species; the strength and durability are dependent on the species, conditions that existed while it was growing, and how it was dried. Strength varies with the orientation of the grain and the size, frequency, and location of knots. Wood rots, burns, and is vulnerable to insects. The limitations caused by this variability have been overcome, in part, by the substantial investment of public funds for research, testing and development through a national U.S. laboratory. Similar subsidies are needed to enable the use of a wider range of more sustainable materials and systems.

Yet another obstacle exists around gaps in materials guidance that contribute to operational risk. Where the functionality or utilization of materials is not fully understood, the lack of information guiding the use of materials can contribute to operational risk in implementing green or conventional projects. For instance, the use of fiberglass insulation is sub-optimal for very cold climates given its thermal properties and functioning, observes Chris Ives of EriA EcoSystems Canada.[110] John Straube, international building science consultant, concurs, noting fiberglass *"as normally installed performs more poorly than rated R-value under both very cold and very hot conditions. In -40 temperatures reductions of 35 to 40 per cent can be expected."* [111] Therefore, using this material in cold climates brings with it some environmental risk because it doesn't insulate as well as it should and therefore doesn't provide optimal reduction of energy use and may create condensation problems as well. Prescriptive approaches to insulation, including the use of foam, without appropriate guidance about resulting reduced drying capacity of building assemblies utilizing such materials, can result in trapped moisture with the range of accompanying consequences including moisture-related building failures.

Lastly, a persistent obstacle to using alternative materials arises out of fear about liability. According to John Straube, the fear among regulatory staff is that their use of their legally granted and protected judgment and authority will expose their jurisdiction to liability. He notes, *"[I]n my experience when it comes to almost all building-related regulations, code officials, planning staff, local health departments, fire inspectors, etc are often driven by a desire to ensure that they or their organisation is not blamed if something goes wrong. This is not risk reduction, or risk management, it is what I call risk displacement. In most cases the risk can be displaced usefully to a designer or builder or manufacturer. This is a powerful tool for knowledgeable people, as they can accept the risk, thereby gaining approval, and then manage the risk through their skills and intelligence. Alas, the downside of this is that if ANYTHING goes wrong, the failure is usually ascribed to the one thing that is different, even if it is not at fault. In many cases officials at all levels will not allow someone to assume the risk, even if the assumer is an expert. This is the scenario with vapor barriers for example: the risk is very low or actually lower, but a code official will insist a vapor barrier be installed even though I, a world expert, say it is more risky to install in a certain scenario, and even though the architect of record is willing to formally assume responsibility (risk)."*

Regulatory Provisions That Need To Be Updated or Eliminated

There will always be provisions in codes and other regulations that are out of date or in need of revision. Many relate to the need for greater water, energy, or resource efficiency or new knowledge about health or performance concerns related to materials or equipment. Examples include plumbing code and public health regulations requiring all water used in buildings to be potable water; and all used water, including greywater, to be treated as though it were raw sewage. This could be interpreted to outlaw reuse and onsite treatment of greywater. Similarly, regulations prohibiting rainwater harvesting for interior uses (particularly for non-potable uses) need to be updated to reflect the growing need for water conservation. Current data should be gathered about

110 Ives, Chris, founder, EriA EcoSystems Canada, former project officer, Canada Mortgage and Housing Corporation, personal communication with Sonja Persram, June 2008

111 Straube, John, Associate Professor, University of Waterloo, Dept of Civil Eng. and School of Architecture and international advisor, Building Science Corporation, personal communication with David Eisenberg, July 6, 2008

actual versus perceived risk for both greywater and rainwater harvesting. While many jurisdictions offer regulatory guidance on rainwater harvesting systems, other regulations and codes related to onsite wastewater treatment and reuse are still problematic.

Some of these types of barriers exist within land use and zoning regulations, while others are specifically related to building, plumbing, energy and other codes. Zoning examples include regulations that prohibit district heating and neighborhood-scale energy, water or wastewater treatment systems and laws that mandate minimum house sizes prohibiting smaller homes. On the building side, examples include health departments that may require oversized wastewater drainage pipe sizes based on antiquated estimates of fixture and sewer flows, or building departments that allow concrete balconies in cold climates that are not thermally disconnected from the interior spaces creating heat loss, moisture and corrosion problems.[112]

Regulatory Provisions that Need to Be Added

New provisions are needed that support the shift towards sustainable and regenerative development practices. The attitude that persists in many building departments, that "if it isn't specifically in the code it is not allowed," underscores the need to continually update codes to include viable options and cover new concerns. For instance, passive survivability [113] [114] (the ability of a building to serve the basic needs of its occupants when disconnected from external utilities) needs to be incorporated into codes as a means for regulators to ensure protection of health and safety. Similarly, passive provision of water and wastewater services, and in the event of extended loss of power, food security,[115] should also be included.

Provisions enabling optimal solar orientation and solar access, balanced with recognition of the benefits of shade and the need for solar access for individual or community gardens should be included in building and land use codes.[116] Pre-plumbing for solar water heating, greywater systems, or rainwater harvesting should be required where appropriate. Policies and guidelines need to be created to facilitate residential renewable power generation, including solar, wind, micro-hydro and potentially small-scale methane generation and storage.

Regulatory requirements for building and appliance labels enable knowledge transfer about high performance to industry and the public. Incorporating performance and third-party certification in codes and regulations (particularly where productivity becomes commonly quantifiable) allows market validation. Also, regulatory bodies in related finance, appraisal, investment and insurance sectors could more easily differentiate value between green and conventional buildings, in their products, operations and portfolios.

Incentives, Disincentives and Perverse Incentives

There is a set of economic barriers that are best dealt with by incentives – and disincentives – which counter the impacts of regulatory challenges discussed elsewhere in this section. Some of the challenges which arise are caused by regulatory gaps that influence markets away from sustainable practices. Others are the result of market conditions devoid of triple bottom line concerns and which incentivize short-term gain and ignore long term risk. Some have come about because they were based on assumptions of stable climate, infinite resources and zero impacts of the built environment on natural systems, which now should be revised in response to the emergent crises. The approaches and their rationales are presented in the Recommendations section of this report.

112 Liefhebber, Martin, MRAIC. Personal communication with Sonja Persram, April 2008.

113 Wilson, Alex. "Passive Survivability: A New Design Criterion for Buildings," *Environmental Building News* 15:5, May 1, 2006

114 Wilson, Alex. "Passive Survivability and Building Codes," *Building Safety Journal*, November-December 2008

115 Persram, Sonja. "Extremes," January 15, 2007, iGreenBuild.com

116 Persram, Sonja. "Solar Access Issues," June 26, 2008, iGreenBuild.com

Perverse incentives, whose origins are similar to the economic barriers described above, encourage actions that are in opposition to sustainability goals. For example, Ashok Gupta[117] of the National Resources Defense Council and Rodney C. McDonald, Chief Building Official for the Province of Manitoba[118] note that a major challenge to encouraging energy conservation is that (most) utilities' revenues increase with consumption. This is a regulatory challenge for both energy and water utilities. In September 2007 in the State of California, utilities decoupled their revenue streams from energy consumption so that revenues increased with supports for conservation and demand management.[119]

A split incentive arises from conflicting Commercial Property Owner and Tenant goals in commercial property triple net lease scenarios. Owners in these scenarios, if they pay for green building measures, may not necessarily reap benefits because their tenants pay the utility bills. To address this concern, Thomas Properties Group has been changing their portfolios' lease structures since 2006 from net to gross, and given their lease cycles, are expected to have all gross leases after several years.[120] REALpac's Green Lease allows landlords and tenants to set sustainability targets, has provisions for green renovations, and allows the landlord to engage in carbon offsetting and potential carbon trading.[121]

Another major barrier is the lack of market-based incentives and building evaluation system preference for passive and low-embodied energy strategies, versus the abundance of incentives for the purchase of higher tech solutions. These gaps make achieving net zero energy projects much more expensive and increases their ecological footprint, given high tech solutions' higher operating costs. Thus a powerful opportunity is lost, to create a strategic preference for the most cost effective and beneficial strategies. This is particularly important when state and local governments count on voluntary programs to achieve their higher energy efficiency targets.

Given the lack of credible evaluation of the full costs of underperformance and the benefits and conferred value of high performance, the market has no means to convey full economic benefit to developers, builders, building owners, tenants, occupants and other stakeholders including society at large. Lacking both enforcement and information about financial benefits, fears of higher first costs will continue to be seen as a disincentive for projects to pursue sustainability goals unless motivated to so for other reasons.

The difficulty of successfully navigating the systemic and specific regulatory obstacles to sustainable development continually drives projects toward conventional practices - the path of least resistance. This amounts to a preference in the regulatory realm for conventional approaches over sustainable ones. However, the magnitude of the risks and associated costs of maintaining the status quo demands change. Once the full risk profile of projects is included in regulatory considerations, it will become more difficult and expensive to gain approval for the most damaging projects than for the most beneficial ones. Governments in general, and the regulatory realm in particular, need to act decisively to reverse this preference as human and environmental health depend on it.

117 Gupta, Ashok. Personal communication with Sonja Persram, July 14, 2008

118 McDonald, Rodney C. Personal communication with Sonja Persram, July 2008

119 Progressive States Network, "Utility Decoupling: Giving Utilities Incentives to Promote Energy Efficiency," September 10, 2007: http://www.progressivestates.org/content/671/utility-decoupling-giving-utilities-incentives-to-promote-energy-efficiency#1

120 Craig Sheehy. Personal communication with Sonja Persram, 2006.

121 RealPac, National Standard Green Office Lease for Single-Building Projects Version 1.01 – 2008: http://www.realpac.ca/s_223.asp

MODULE 4

RECOMMENDATIONS & CONCLUSIONS

In order to facilitate the implementation of sustainability goals and the new federal green building and infrastructure initiatives, there should be a parallel commitment to green the regulatory infrastructure in advance of these projects.

RECOMMENDATIONS & CONCLUSIONS

The building regulatory community, and regulators in general, understand their responsibility for safeguarding the public, and separating public and private interests. However, because of the nature of the regulatory realm, large and serious risks may not always be addressed and often efforts to address them can be stymied by the regulatory process itself. In order to minimize systemic obstacles and appropriately balance all risks, building and related regulatory systems would benefit from an internal system designed to periodically investigate and evaluate systemic effects of the regulations themselves. This could be accomplished by asking a set of questions such as: What and who are we protecting? From what risks? What have we missed? How might this work be carried out to create the greatest good, not just avoid the greatest harm?

Despite increasingly clear documentation of growing risks related to climate change, non-renewable energy supply, water shortages, resource depletion and a range of other threats to human and ecosystem health, the regulatory realms for the built environment have been slow to embrace the seriousness of these risks or the fullness of their responsibility for addressing them. However, key climate change and economic organizations have stressed that both regulatory and market-based measures need to be applied given the planetary urgency. The following excerpt is from the Organization of Economic Co-operation and Development (OECD) Environmental Outlook to 2030:[122]

122 OECD Environmental Outlook to 2030: http://www.oecd.org/document/20/0,3343,en_2649_37465_39676628_1_1_1_37465,00.html

> *"Develop policy mixes, or combinations of instruments, tailored to specific national circumstances to tackle many of the urgent remaining environmental problems. Mixes of policy instruments are needed because of the complex and often cross-sectoral nature of environmental issues. This typically means combining a robust regulatory framework with a variety of other instruments, such as strong pricing mechanisms, emissions trading or tradable permits, information-based incentives such as labeling, and infrastructure provision and building codes. In a well-designed mix, instruments can mutually support each other. For example, a labeling scheme can enhance the responsiveness of firms and households to an environmentally related tax, while the existence of the tax helps draw attention to the labeling scheme."*

International and national responses to climate change-related risks will likely have a profound effect on the entire built environment, both through direct regulations addressing the magnitude of this sector's carbon footprint, and market regulations which will, in essence, put a price on carbon. Such regulatory and market-based changes will almost certainly drive an ongoing process of continuously increasing performance requirements not only for energy and greenhouse gas emissions, but across the spectrum of sustainability goals for the built environment.

In order to facilitate the implementation of sustainability goals and the new federal green building and infrastructure initiatives, there should be a parallel commitment to green the regulatory infrastructure in advance of these projects. A comprehensive, integrated approach is needed to align regulations for the built environment and related sectors with the actions necessary to address the existing and emerging problems. The resulting regulatory synergy would leverage enhanced economic stimulus and green job development programs. It also would go far to ameliorate environmental and societal challenges today and into the future.

Solutions to overcoming the challenges described in this report range from dealing with specific barriers in specific projects to changing the paradigm and goals at a systemic level. At the specific, more easily resolved end of the spectrum, barriers can be dealt with by providing appropriate technical information to the regulators, or solving specific issues in the approvals process. That will require investment in research, testing, development and deployment of the most effective strategies. Further along the spectrum is the need for changes to existing codes and regulations as well as the development of new provisions or standards. The systemic paradigmatic end of this range involves shifting the goals of the regulatory system to encompass and balance new understanding about risks and their impacts. It expands regulatory focus to include the future, by adding the explicit goal of safeguarding the welfare of future generations. This paradigm therefore would achieve larger and longer-term societal, environmental and economic goals. Recommended solutions to both specific and systemic barriers are discussed in the Recommendations section.

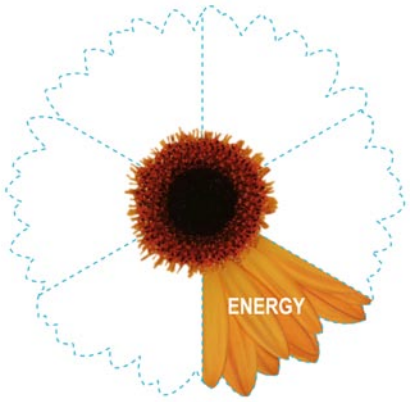
RECOMMENDATIONS

1) IDENTIFY AND ADDRESS REGULATORY IMPEDIMENTS TO GREEN BUILDING AND DEVELOPMENT

The Living Building Challenge, as well as most green building and sustainable development programs, begins with the site and with place-based issues, recognizing that truly sustainable and regenerative solutions are inescapably interconnected with site conditions, and affected by land use and zoning considerations. The conventional compartmentalization of planning and zoning, building, and other regulatory functions impedes the realization of the goals of deeply integrated projects, and sometimes of the goals of the regulatory entities as well.

The Rocky Mountain Land Use Institute's Draft Sustainable Community Development Code provides an excellent framework, revealing a wide range of conflicts between regulatory and community sustainability goals, and offers best-practice examples for appropriately resolving these conflicts.[123] The City of Seattle's consolidation of their planning department and the department responsible for zoning and building approvals and enforcement, into the Department of Planning and Development demonstrates the benefits of dissolving these regulatory silos.[124] Site-related issues are not treated separately here, but are instead integrated into the discussions of regulatory impediments that follow.

Energy



Regulatory policies must facilitate reductions in energy consumption and greenhouse gas emissions; energy efficiency and renewable energy; and must enable district level distributed energy systems. Recommended measures include:

- Address the current regulatory imbalance that supports centralized over distributed energy systems:
  - » Eliminate zoning and utility regulations that inhibit neighborhood-scale energy systems; district heating, cooling and power systems; cascading uses of energy; and the sharing of heat, cooling and power across boundaries between buildings, and across property lines, roads, and other jurisdictional divisions.
  - » Provide regulatory support for conservation and demand management (CDM),[125] cogeneration, distributed and district systems.[126] Renewables should be given priority access to the grid over non-renewable sources.[127] [128] Combining solar and wind in a portfolio reduces variability[129] as does siting them over a large geographic area, which combined with CDM and renewables enables addressing base load, while renewables

123 (RMLUI)'s draft *Sustainable Community Development Code* identifies conflicts between sustainable community goals and standards, and the goals of conventional land use planning, zoning and building regulations. http://www.law.du.edu/index.php/rmlui/sustainable-community-development-code

124 Eisenberg, David. "Leading the Way: Building Departments as Community Resources for Better Building Practices," *Building Safety Journal*, June 2003

125 Peters, Roger, Winfield, Mark and Cobb, Paul. "Renewable is Doable: A Smarter Energy Plan for Ontario, Report No. 1: Analysis of Resource Potential and Scenario Assumptions," August 1, 2007, and Godin, Mark, "Report No. 2: Analysis and Scenario Modelling of the Ontario Power System," July, 2007: http://www.pembina.org/pub/1496

126 Lovins, Amory B., Sheikh, Imran, and Markevich, Alex. "Nuclear Power: Climate Fix or Folly?," December 2008, Rocky Mountain Institute: http://www.rmi.org/images/PDFs/Energy/E09-01_NuclPwrClimFixFolly1i09.pdf

127 German Federal Ministry for Environment, Nature Conservation and Nuclear Safety, *The Renewable Energy Sources Act*, August 2004: http://www.bmu.de/english/renewable_energy/doc/6465.php

128 Mandel, Jenny. "1. Renewables: Germans struggle to resolve new sources' conflicts with electricity grid," *ClimateWire* May 28, 2008, in Environment and Energy News: http://www.eenews.net/public/climatewire/2008/05/28/1

129 Buhayar, Noah. *Getting a (Firm) Grip on Renewables*, Rocky Mountain Institute

energy storage helps address peaks (due to the dispatchability).[130] [131] [132] [133] Distributed systems also enable savings on transmission losses that are prevalent in centralized systems.

» Create new code provisions and permit guidance for all active onsite renewable power generation including solar, wind, micro-hydro and potentially small-scale methane generation and storage.

» Optimize solar orientation and solar access balanced with recognition of the benefits of shade, and develop a solar/shade access model ordinance to enable both active and passive solar measures.[134] For example, the State of California's Solar Access Laws (easements) and the Solar Shade Control Act, which encourages trees and other natural shade except where neighboring solar access would be encroached. Utilize American Wind Energy Association model zoning ordinance for small wind turbines.[135] The ordinances should remove setback and height restrictions to allow outsulation[136] and other energy efficiency and renewable energy measures,[137] and override developer covenants, conditions and restrictions and homeowner association impediments.

» Include renewables storage in Feed-in-Tariffs in order to make wind dispatchability economically feasible to address peak loads.[138]

» Mitigate hurdle rates for energy efficiency measures[139] [140] and renewables.[141] Hurdle rates are organization's internal rates of return justifying investment. High hurdle rates for distributed systems are known disincentives of special concern in light of research noting high non-renewable centralized system costs such as those for nuclear and coal-fired plants.[142] [143]

» Encourage the inclusion of life-cycle analysis of embodied and operating energy in the development of building and energy codes, in order to ensure that the remaining fossil fuel supply and passive resources are optimally applied.[144]

130 The California Independent System Operator (CaISO)'s supports including renewables into the grid through storage in order to help address peak shifting and dispatchability, among other benefits: Integration of Renewable Resources. *California Independent System Operator*, November 2007, cited in Peters et al, ibid.

131 Peters, Roger and Burda, Cherise. *The Basics on Base Load: Meeting Ontario's Base Load Electricity Demand With Renewable Power Supply*, Pembina Institute, September 26, 2007: http://re.pembina.org/pub/1530

132 Peters, Roger, with Lynda O'Malley. *Storing Renewable Power*, Pembina Institute, June 2008

133 Archer, Cristina L. *Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms*, 2007, Department of Civil and Environmental Engineering, Stanford University

134 Persram, Sonja. "Solar Access Issues," June 26, 2008, iGreenBuild.com: http://www.igreenbuild.com/cd_3147.aspx

135 American Wind Energy Association, Small wind, AWEA Model Zoning Ordinance

136 Recommended by Liefhebber, Martin, personal communication with Sonja Persram, op. cit

137 See also the Rocky Mountain Land Use Institute's Sustainable Community Development Code: http://www.law.du.edu/index.php/rmlui/sustainable-community-development-code

138 Tim Hennessey, CEO, VRB Power Systems Inc. Personal communication with Sonja Persram, May 2008, notes utilities do not support wind "as it is not dispatchable on its own – so the utility has to build its generation to duplicate delivery from wind"... consequently "There will be resistance to wind proliferation"... "unless one gets 1) the industry to accept that there are alternatives i.e. wind + storage, and 2) tariff adjustments to allow wind sources to do wind + storage themselves."

139 Nyquist, Scott. "Curbing Global Energy Demand Growth: The Energy Productivity Opportunity," McKinsey & Company, Inc., July 2007: http://piee.stanford.edu/cgi-bin/docs/Snowmass_Presentations/7_27_2007/27Presentation_Nyquist.pdf

140 IPCC, Climate Change 2001: Working Group III: Mitigation, Energy Supply http://www.ipcc.ch/ipccreports/tar/wg3/213.htm

141 United Nations Environment Program, Financial Risk Management Instruments for Renewable Energy Projects, 2004

142 Mazria, Edward and Kershner, Kristina. "The 2030 Blueprint: Solving Climate Change Saves Billions," *Architecture 2030*, 2008.

143 Lovins, Amory et al. "Small is Profitable." http://www.smallisprofitable.org/

144 Allen, Greg, Sustainable Strategist, HOK, personal communication with Sonja Persram, August 13, 2008

- Address the regulatory impediments to high performance buildings in the U.S. and Canada by:
  - » Indirect federal support: the U.S. federal government cannot mandate state code standards, but put a price on carbon and supported state and local action to staff and train regulators and inspectors based on energy and carbon targets per capita. [145] [146] [147] [148] [149]
  - » Requiring energy performance benchmarking for all existing residential and commercial buildings.
  - » Ratcheting up performance standards for buildings and appliances so that the current best in class become minimum requirements in a few years (similar to Japan's and the California Title 24 systems). Use pre-requisites and third-party certification to enable validation of enhanced building and appliance performance.
  - » Requiring third-party evaluation protocols on building sale and when conducting major renovations to enable prospective buyers to understand their expected future energy costs, and facilitate enhanced energy efficiency.
  - » Aligning performance-based energy codes with Architecture 2030 goals using Interim Code Equivalents; that is, the levels within each building energy code and standard that will allow state and local governments to achieve these targets.[150]
  - » Updating building codes to address building energy design flaws, such as ensuring concrete balconies in cold climates are thermally disconnected from interior spaces.[151]
- Begin a process to incorporate passive survivability principles into codes as a means for regulators to provide broader protection of public health and safety.[152] This includes removing regulatory impediments to provision for food security at both a building and at a community level.[153] This would automatically highlight the advantages of passive design strategies, improving overall performance whether buildings are using external utilities or not. (See the water section for additional measures).
- Eliminate laws that mandate minimum house sizes and instead consider zoning regulations that mandate maximum house sizes.
- Reassess the basis for the regulatory requirements in terms of what they protect and whether the public interest is served when viable opportunities to optimize crucial resources are constrained by regulations, independent of their safety or efficacy.

145 Gupta, Ashok. Personal communication with Sonja Persram, July 15, 2008: made this and the following two recommendations. These support the iCAP legislation introduced by Congressman Markey (see note following).

146 Voluntary Rating Systems, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/voluntary_rating_systems.cfm accessed June 21, 2008

147 Energy Codes and Standards, US Department of Energy, Energy Efficiency and Renewable Energy: http://www.eere.energy.gov/states/alternatives/codes_standards.cfm accessed June 21, 2008

148 According to Peter Garforth, Principal of Garforth International LLC, based on the average of all new construction, approximately 20% of new buildings in the United States are underperforming by 20% or more, compared to energy codes requirements. Personal communication cited in Persram, Sonja, USA, in International Sustainable Building Policy Initiatives, Nils Larsson, lead author, Canada Mortgage and Housing Corporation, 2006.

149 Legislation introduced by Congressman Edward J. Markey: Investing in Climate Action and Protection Act: http://markey.house.gov/index.php?option=com_content&task=view&id=3376. Proceeds of the program will be invested in a variety of programs in addition to supporting the ability to pay for a low-carbon technology fund, a national energy efficiency fund, green jobs training and worker transition assistance, renewable energy and efficiency RD&D, renewable large scale deployment incentives, and distributed RE deployment rebates.

150 Mazria, Ed, and Kershner, Kristina. "Meeting the 2030 Challenge Through Code Equivalents," *Architecture 2030*, 2008

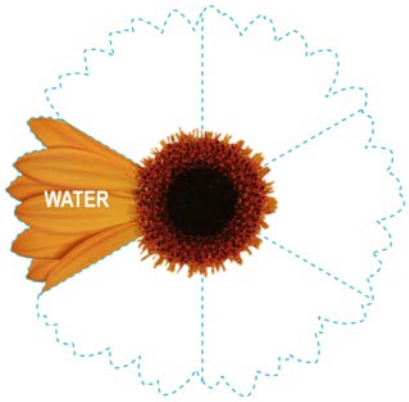
151 Liefhebber, Martin, MRAIC. Personal communication with Sonja Persram, April 2008

152 Wilson, A., Atlee, J. and Webber, D./Halsall Associates. "Paper 3b: Institutional Efforts for Green Building Approaches in Canada and the United States," Commission for Environmental Cooperation, March 2008

153 Persram, Sonja. "Extremes," January 15, 2007, www.iGreenBuild.com

- Facilitate regulatory mandates in the insurance, finance and investment sectors to require all companies responsible for portfolios to act on climate change issues in their own operations and in their portfolios.[154]

Water



Regulatory policies should facilitate reductions in potable water consumption, address wastewater quantity and quality challenges, and reduce stormwater flows. Recommendations include:

- Remove regulatory barriers to using cascading quality of water.
- Enable supply as well as conservation and demand management to be addressed in an integrated fashion that includes both centralized and distributed systems.
- Provide support in distributed systems for operations, monitoring and maintenance service delivery – which are job creation opportunities.
- Address the watergy concept, that is, the need for greater energy efficiency in water, wastewater and stormwater infrastructure, given electricity costs for pumping water and greater water efficiency in the production of energy.[155]
- Based on updated health or performance concerns related to water quality, revise existing codes and regulations:
  - » Requiring all water used in buildings to be potable water
  - » Requiring all used water, including greywater, to be treated as though it were raw sewage
  - » Outlawing reuse and onsite treatment of greywater
  - » Prohibiting rainwater harvesting for interior uses (particularly for non-potable uses). Changes also should include amending setback provisions to allow rainwater harvesting equipment to encroach and this encroachment could be included on property deeds and recognized via payment to the city – as opposed to banning this outright.[156]
  - » Containing impediments to sharing onsite available resources across property boundaries to facilitate neighborhood level systems for water, wastewater and stormwater.[157]
  - » Prohibiting neighborhood-scale water and wastewater treatment systems.
  - » Requiring oversized wastewater drainage pipe sizes based on antiquated estimates of fixture and sewer flows (per health departments). However, these also must address volumes that are required to maintain sewer pipe flows.[158]
  - » To include pre-plumbing for solar water heating, greywater systems or rainwater harvesting, where appropriate.
- As a passive survivability measure, include provision for on-site and neighborhood water and wastewater services.

154 Evan Mills. Personal communication with Sonja Persram, April 2008: Evan Mills is energy analyst at Lawrence Berkeley National Laboratory and a member of the International body of scientists under the Intergovernmental Panel on Climate Change (IPCC).

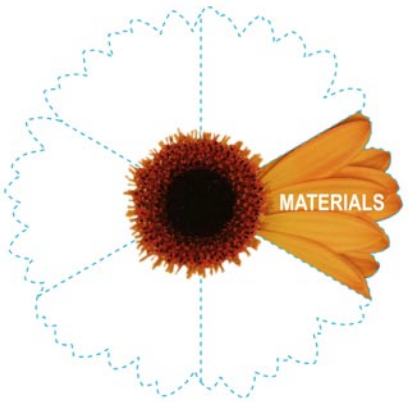
155 Buehrer, Mark. Personal conversation with Sonja Persram, April 2008.

156 Liefhebber, Martin. Personal communication with Sonja Persram, op cit.

157 See: TreePeople http://www.treepeople.org/vfp.dll?OakTree~getPage~&PNPK=207

158 Mueller, Thomas. Personal communication with Sonja Persram, May 2008.

Materials



- Develop inter- and intra-jurisdictional policies that support waste management revenue streams appropriate to sustainability goals. For example, facilitate commercial waste diversion and reuse requirements so that tipping fees are not used to fund residential diversion; and enable deconstruction through appropriate scheduling of demolition and building construction permits.
- Update building and energy codes and valuation systems, and provide regulatory guidance on natural building materials, low-energy, and passive systems (see Recommendation 6).
- Ensure appropriate guidance is available for materials, particularly for those in widespread or prescripted use that are subject to operational risk.
- Develop closed-loop waste management systems to enable appropriate reuse of materials, local materials supply in a low-carbon environment, and local economic development.
- Adopt The Natural Step and/or the Precautionary Principle for guidance in government decision-making, and in building valuation systems.

2) CREATE INCENTIVES MATCHED WITH DESIRED GOALS

For green development to flourish, it is vital to facilitate a comprehensive series of green development incentives for regulatory bodies in building, planning and other sectors related to the built environment which match desired outcomes and recognize enhanced green building value. Recommendations include:

- Facilitate a comprehensive series of green development incentives for regulatory bodies in building, planning and other sectors related to the built environment, including the following:
  - » Decouple energy[159] [160] [161] and water utility[162] revenues from sales, so revenues do not increase with consumption. This will allow utilities to engage in conservation and demand management programs without an associated loss of income.
  - » Enable realistic pricing policies for energy production that include typically hidden costs to health, environment and the economy.[163] Enable increasing block rates for water use, taking into account the ability to pay.[164]
  - » Facilitate federal and state incentives to encourage passive measures in minimizing energy use.[165] [166] [167]
  - » Use tenant incentives to mitigate plug loads such as retailer sales incentives for Energy Star labeled products.[168]
  - » Address split incentives – such as by modifying practitioners' compensation to reward building performance.[169] For example, rewarding performance and life cycle value instead of the conventional project-cost methods would empower the use of design efficiencies such as passive measures which may result in a lower overall cost.
  - » Develop innovative energy efficiency and renewable energy financing systems (while enabling local economic development), such as:
    - "Negawatt" or conservation measures to avoid the need for new non-renewable power plant infrastructure.[170]

159 Gupta, Ashok. Personal communication with Sonja Persram, July 15, 2008

160 McDonald, Rodney C., Chief Building Official, Province of Manitoba. Personal communication with Sonja Persram, July 2008

161 Progressive States Network, "Utility Decoupling: Giving Utilities Incentives to Promote Energy Efficiency," 2007

162 Townsley, Paul, Nelson, Peter, Wicks, Floyd E., Spivy-Weber, Frances, and Cohen, Ronnie. "Letter to California Public Utilities Commissioners," California Water Service Company, Conservation Recommendations

163 Danforth Greens. "A Realistic Energy Plan for Toronto:" http://danforthgreens.ca/realistic-energy-plan/conservation/

164 American States Water Company: http://www.aswater.com/SD-60-v1-Conservation_Policy_Recommendations_Final_CPUC_Transmittal_Copy.pdf

165 Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino. 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Accessed: http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter6.pdf

166 Duerksen, C., Heller, E., Van Hemert, J., Hirt, J., Holmes, J., Kacala, A., King, L-A., and White, D. *Sustainable Community Development Code: A Code for the 21st Century Beta Version 1.0*, Rocky Mountain Land Use Institute, 2008 http://lists.unc.edu/read/attachment/4600121/3/Sustainable_Community_Development_Code_Beta_Version_1.0_w_cjd_edits.pdf

167 http://www.passiv.de/English/PassiveH.HTM

168 Gupta, Ashok, op cit.

169 Eley Associates, "Energy Performance Contracting for New Buildings," http://www.rmi.org/images/PDFs/BuildingsLand/D04-23_EleyPerfCntrEFRpt.pdf

170 "Houston Undertakes Existing Homes Retrofit Program," *RESNET Notes*, May 2008. Since 1982, energy efficiency programs reduced the city's generation needs by over 800 MW, and they refer to Demand Side Management program as their 'Conservation Power Plant' or 'Negawatt Plant':http://www.resnet.us/_members/notes/2008/rn2008-05.pdf

- Implement utility system benefit charges, or public benefit funds,[171] aggregated from small increments (of $1 or $2) to ratepayer bills. Energy utilities employ these to support low income customers and provide incentives for energy efficiency and renewable energy, technical assistance, training, research, and green building loans or grants.
- Incentivize storage of renewables using innovative tax incentives such as in the States of Utah[172] [173] and Texas.[174]
- Renewable Portfolio Standards/Feed-In Tariffs/Production Incentives for government purchasing and energy portfolios.
- Property tax exemptions for green building measures such as energy retrofits and installation of renewables, and support for passive solar as well as for buildings certified to high performance standards.
- Technical assistance programs[175] that support training for retrofitters and installers, as well as educational information about efficiency measures and costs (and benefits) for owners and tenants.
- Develop on-bill financing systems to include passive measures in addition to technological ones.[176] The State of California has initiated an on-bill utility financing program to support 0% interest, unsecured, post-energy audit retrofits for small businesses, in which savings must exceed costs and the financing is not transferable. Passive measures are not included.
- Fund renewables and green power using Renewable Energy Mitigation Program fees for over-budget energy use.[177] For example, the City of Aspen and Pitkin County, Colorado's Renewable Energy Mitigation Program and the local building code requires new homes to meet a strict energy "budget." Homes consuming additional energy have the option of installing a renewable energy system or paying a mitigation fee which supports energy efficiency and renewable energy projects benefitting the community. Since its inception in 2000, the program has raised nearly $8 million helping offset greenhouse gas emissions, funding numerous community benefit projects, educating the design and construction community, and supporting the development of renewable energy companies in the region.

171 New York State Energy Research and Development Authority (NYSERDA) applies $175 million annually of these funds towards a broad range of EE/RE Energy $mart programs: http://www.nyserda.org/pdfs/Combined%20Report.pdf , http://www.nyserda.org/Programs/Technical_Assistance/default.asp. Currently, 21 states have EE/RE incentives. Developing system benefit charges – for water – to help support the ability to pay (as prices rise), and larger scale systems' incentives is more controversial. However where an onsite or district alternative system enables a centralized water authority to avoid infrastructure supply, repair, and expansion costs, there should be some financial incentive for this benefit to society.

172 Utah Geological Survey, Renewable Energy Incentives: http://geology.utah.gov/SEP/incentives/rincentives.htm#retaxcred

173 *Utah Energy Saving Systems Tax Credit (ESSTC) Rules*, R637 Natural Resources, Energy and Resource Planning, http://geology.utah.gov/SEP/incentives/re_taxcredit/pdf/retc_rules_pre07.pdf

174 *Texas Tax Code Incentives for Renewable Energy*, State of Texas, State Energy Conservation Office: http://www.seco.cpa.state.tx.us/re_incentives-taxcode-statutes.htm accessed June 19, 2008

175 New York State Energy Research and Development Authority, *Technical Assistance Program*: http://www.nyserda.org/Programs/Technical_Assistance/default.asp

176 Small Business California, "On Bill Financing: An Energy Saving Access to Capital Solution for California small businesses/municipalities/water users": http://www.smallbusinesscalifornia.org/SB-Cal%20On%20Bill%20Financing%20Presentation.ppt

177 Renewable Energy Mitigation Program (REMP): http://www.aspencore.org/sitepages/pid31.php> : http://www.aspencore.org/sitepages/pid45.php

- Local Improvement Charges[178] [179] [180] [181] for energy efficiency retrofits and renewables, financed by low-interest municipal loans. These are a lien provision that attaches costs for the measures to the property, not the owner, and are repaid on the owner's property tax bill. This policy therefore addresses the resistance to energy improvements that arises from concerns about access to upfront financing and short or uncertain ownership duration because they are transferable. Yukon Territory in Canada instituted this measure for renewables and utilities in outlying regions years ago, and the City of Berkeley developed a "Solar Loan" policy framework for a renewables pilot, with retrofits to follow. Many more regions in the U.S. [182] and Canada are considering the feasibility of implementing this measure. Social equity is also a factor in this measure, where eligibility is not assessed based on credit-worthiness.

» Employ developer incentives such as:

- Fast-tracked permitting and reduced fees.[183] [184]
- Reduced parking requirements given facilitation of alternative modes of public transportation.
- Removing institutional impediments to incorporating new and innovative green building technologies through education, technical assistance, and financial grants.

» Provide financial incentives that address societal benefits and improved public health such as:

- Reduced consumption of natural resources.
- Reduction of heat island effect.
- Avoidance of infrastructure supply, repair, and expansion costs, such as from reduced stormwater runoff.
- Providing a pedestrian-friendly environment.
- Improving indoor environmental quality.

• Develop Appraisal and Portfolio Valuation Financial Incentives and Systems. Organizations, portfolios, governments and investors in the financial, appraisal,[185] investment[186] and

178 Peters, R., Horne, M., and Heap, D. "Using Local Improvement Charges to Finance Building Energy Efficiency Improvements: A Concept Report," May 1, 2004, http://www.pembina.org/pub/170.

179 Peters, R., Whitemore, J., and Horne,M. "Using Local Improvement Charges to Finance Energy Efficiency Improvements: Applicability Across Canada," June 1, 2005, http://www.pembina.org/pub/197

180 Persram, Sonja. "Local Improvement Charges, Part II," June 15, 2007, iGreenBuild.com

181 Mayor's Office Press Release, Berkeley Breakthrough on Financing Solar Energy and Energy Efficiency, October 23, 2007 http://www.cityofberkeley.info/mayor/PR/pressrelease2007-1023.htm accessed most recently June 22, 2008: The City of Berkeley, California has instituted Local Improvement Charges for solar installations, financed by a 20-year municipal bond, such that the renewable is attached to the property, not the owner – and the financing is repaid through municipal taxes. This measure effectively removes the upfront outlay disincentive for owners unsure of the length of time they will hold their property, as it allows both costs and benefits to be obtained by the current owner, regardless of duration of ownership. The city will be extending this financing method in future to renewables. The idea was first mentioned in Roger Peters et al's Pembina Institute reports in which they examined the barriers to transferability of the successful system from Yukon Territory (for renewables and telephone utility provision in outlying regions), to all of Canada. Various regions in Canada have been considering this approach. See also: Kho, Jennifer, Berkeley to Finance Solar Installations, November 8, 2007, http://www.greentechmedia.com/articles/berkeley-to-finance-solar-installations-278.html http://www.toolkit.bc.ca/success-stories/dawson-creeks-energy-plan

182 Fuller, Merrian C., Portis, Stephen Compagni, and Kammen, Daniel M. "Toward a Low-Carbon Economy: Municipal Financing for Energy Efficiency and Solar Power," *Environment Magazine*, January-February 2009: http://www.environmentmagazine.org/Archives/Back%20Issues/January-February%202009/FullerPortisKammen-full.html

183 Olsen, Erik L. *The City of Chicago Green Permit Program*: http://www.iccsafe.org/news/green/0807BSJ24.pdf

184 Olsen, Erik L. Department for Construction and Permits, City of Chicago, http://www.illinoisashrae.org/HealthySchool/ASHRAE%20Green%20Permit%20Program.pdf

185 Corps, Chris. "Background Paper 2c: Toward Sustainable Financing and Strong Markets for Green Building: Valuing Sustainability," Commission for Environmental Cooperation, 2008

186 Ambachtsheer, Jane. "A Climate for Change: A trustee's guide to understanding and addressing climate risk," 20 August 2005, Mercer, http://www.mercer.com/referencecontent.htm?idContent=1189970

insurance[187] fields should engage in facilitating green buildings and addressing climate change as well as other social, environment and economic risks. Portfolio managers in these realms can mitigate both their customers' risk exposure and their own organizations' greenhouse gas emissions and these other risks by measures including:

» Ensuring investment and other portfolio organizations deal with climate risk in accordance with their fiduciary and investor responsibility.

» Facilitating an industry mandate to respond to current and future risk exposure, and portfolio manager action.[188] The National Association of Insurance Commissioners will be requiring insurance companies to disclose their financial climate change risk exposure and actions they are taking to address those risks. Reporting will include activities with policymakers and policyholders, and investment strategy changes.[189]

» Accelerating uptake of design and technological measures for energy efficiency and renewables. Facilitating links between green building measures (e.g. daylighting, natural views, enhanced indoor environmental quality), productivity and appraised value,[190] [191] [192] [193] segmented by building type and use.[194]

» Conducting research to validate preferential appraisals depending on measures' contributions to (for example) higher building performance, rents[195] [196] and occupant productivity.[197] For example, the value of a house should reflect its energy efficiency,[198] and benefits to owners should be included in appraisal regulations for residential properties. Addressing portfolios' and clients' risk exposure to environmental and social challenges,[199] and their capacity to benefit from operations and portfolio opportunities such as greening buildings, and green financial, insurance and investment product differentiation.[200]

» Providing incentives for building evaluations to include life cycle analysis and value assets based on market value instead of on cost.[201]

187 Mills, E. and I. Knoepfel. "Energy Efficiency Options for Insurance Loss Prevention." Proceedings of the ECEEE Summer Study, June 9-14, 1997. Prague, cited in Mills, Evan "From Risk to Opportunity: Insurer Responses to Climate Change," CERES, 2007

188 Ambachtsheer, Jane, op. cit.

189 National Association of Insurance Commissioners: http://www.naic.org/committees_ex_climate.htm

190 eBids – Energy Related Building Investment Decision Support. Cost-benefit research database on high performance building design guidelines associated with productivity, health and environmental benefits.

191 Kats, Greg. *The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force*, October 2003. See also many other reports by Kats.

192 Persram, Sonja, Lucuik, Mark & Larsson, Nils. *Marketing Green Buildings to Owners of Leased Properties*, Canada Green Building Council, 2007

193 Persram, Sonja, Larsson, Nils & Lucuik, Mark. *Marketing Green Buildings to Tenants of Leased Properties*, Canada Green Building Council, 2007

194 Persram, Sonja. Personal communication with Tony Gale, chair of USGBC Social Equity Task Force, April 2008

195 Burr, Andrew, C. "CoStar Study Finds Energy Star, LEED Buildings Outperform Peers," March 26, 2008, costar.com

196 CoStar Group, March 2008: http://www.costar.com/news/Article.aspx?id=D968F1E0DCF73712B03A099E0E99C679

197 Corps, Chris, op. cit.

198 Marilyn A. Brown, Frank Southworth, and Andrea Sarzynski. Brookings Institution, "Shrinking the Carbon Footprint of Metropolitan America," May, 2008: The Real Estate Settlement Procedures Act (RESPA) – which protects homebuyers in case of unforeseen risks - "should be expanded to include the unseen costs related to energy. Sellers should be required to disclose energy costs for several years before the sale. RESPA should also require the uniform disclosure of energy efficient investments or energy-efficient certifications previously awarded to the home."

199 Corps, Chris, op. cit.

200 Persram, Sonja, ibid

201 Corps, Chris, op. cit.

» Require that appraisals include green measures such as energy efficiency, compared to conventional buildings. For example, the value of a house should reflect its energy efficiency,[202] and benefits to owners should be included in appraisal regulations for residential properties.

» Include energy performance, greenhouse gas emissions, water use and green features in real estate listings categories.

3) DEVELOP EDUCATION & ADVOCACY PROGRAMS

Support and facilitate educational partnerships to encourage efficiencies and synergies among all industry stakeholders. Recommendations include:

- Develop curriculum and train regulatory staff to participate in integrated design charrettes to facilitate both improved regulatory input into the design process and improved understanding of the integrated design process among regulatory staff. When those tasked with enforcing the codes and regulations are present during the design process, their concerns, input, understanding and expertise will be present at critical times in the same way that other important stakeholders and participants are included.
- Develop accessible, reliable, up-to-date, and appropriately evaluated information hubs[203] to effectively share best practice solutions to regulatory issues.
- Create an expanding library of code compliance packages[204] [205] for alternatives, containing all relevant information needed by designers, builders, developers and those in regulatory roles.
- Develop the equivalent of the LEED Credit Information Request (CIRs) system for codes to accelerate acceptance of alternative approaches through shared information about successful approval processes.[206]
- Create an alliance of green building and code sector volunteers organized into standing committees to map out pragmatic, structured pathways to developing "alternative solutions." [207]

202 Marilyn A. Brown, Frank Southworth, and Andrea Sarzynski. Brookings Institution, "Shrinking the Carbon Footprint of Metropolitan America," May, 2008: http://www.brookings.edu/reports/2008/~/media/Files/rc/reports/2008/05_carbon_footprint_sarzynski/carbonfootprint_report.pdf more information in: http://www.brookings.edu/reports/2008/05_carbon_footprint_sarzynski.aspx The Real Estate Settlement Procedures Act (RESPA) – which protects homebuyers in case of unforeseen risks - "should be expanded to include the unseen costs related to energy. Sellers should be required to disclose energy costs for several years before the sale. RESPA should also require the uniform disclosure of energy-efficient investments or energy-efficient certifications previously awarded to the home."

203 The hubs would be an adjunct to the DSIRE website for energy retrofits and renewables. There also would be a hub that would be a "DSIRE for water" which would include e.g. brand performance evaluations of water fixtures, appliances and equipment, information on centralized and distributed systems, alternative materials and measures, and comparable sizing of renewables. Additional examples of data that might be included are: Architect Dennis Castellan of Castellan James + Partners Architects, recommends that "industry provide more data on more dimensions of products and/or systems that will allow people to consider products without going through a 'google' life of research. For example, if you are proposing turbines in a traditional subdivision it would be a good thing to know the db levels that the turbine generates in addition to the blade size."

204 Eisenberg, David. "Building Code Compliance Packages: Gaining Acceptance for Alternatives, National Workshop on State Building Energy Codes," June 23-26, 2003: http://www.energycodes.gov/news/2003_workshop/presentations/Eisenberg.ppt These have been proposed by the Development Center for Appropriate Technology to facilitate and accelerate the use and adoption of beneficial alternative equipment, methods, materials and designs. Compliance packages would be compilations, for each alternative, of all relevant information needed by designers, builders, developers and those in regulatory roles so that all parties would have the information they need to design, submit, review, approve and inspect projects utilizing the alternatives. A draft template and concept was presented in 2003 at a national conference on state building energy codes. Conceptually, this information could be included in single PDF documents made available online, and tied to a database of up-to-date information to provide reliable and properly reviewed information for all parties involved. The Building Energy Codes Resource Center's Articles section is an example of this concept , which could be expanded to include a wider range of topics. The USGBC Codes Committee has initiated a process to create the first of these code compliance packages in 2009.

205 Building Energy Codes Resource Center: http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter

206 McDonald, Rodney C., Chief Building Officer, Province of Manitoba. Personal communication with Sonja Persram, July 2008. This would be a measure to share solutions to real problems effectively. "Alternative solutions" (descriptions of how project teams met the objectives of code although the methods used were not identified as "acceptable" solutions within the code) would be stored on the web "hub" described previously, and the solutions would be aggregated until "alternative solutions" are regulated as "acceptable solutions."

207 McDonald, Rodney C., op. cit.

- Engage the U.S. Green Building Council and Canada Green Building Council to mobilize and encourage their members to become involved in codes and standards development processes at local and national levels.
- Create public committee structures to evaluate and support the approval process for alternative materials, methods and designs, like the Portland Alternative Technology Advisory Committee.[208]
- Initiate continuing education credits for participation in regulatory processes.
- Enhance visibility of the benefits of public safety enforcement to encourage adequate funding for regulatory agencies.
- Use building and appliance labels to enable industry and public access to performance data.
- Provide insurers, appraisers and regulators with information about risks of conventional practices and the risk mitigation potential of sustainable strategies.

4) ACCELERATE RESEARCH, TESTING, DEVELOPMENT, DEPLOYMENT AND MONITORING

Support research, testing and development of passive optimization strategies including passive solar and those that eliminate the need for materials, products and systems by design rather than the current near-exclusive focus on technology development. Create a government-funded passive measures research institute – to research, advocate for, and educate about using passive measures – similar to that of the PassivHaus.[209] Specifically support R&D funding for:

- energy efficiency and renewables,[210]
- low-embodied energy materials
- renewables storage[211] [212] [213]
- comparisons of centralized and distributed (energy and water) systems
- analyzing the synergies and potential savings of energy used within water utilities
- analyzing actual vs. perceived risk for both greywater and rainwater harvesting
- dematerializing construction
- optimizing and establishing adequate performance data for lower impact, lower-technology solutions
- Provide support for testing protocols and systems to help address gaps in the availability of viable alternative building materials based on a paradigm shift that avoids materials with negative health or environmental profiles.

208 Portland Alternative Technology Advisory Committee: www.portlandonline.com/ONI/index.cfm?a=215597&c=37423

209 PassivHaus: http://www.passiv.de/English/PassiveH.HTM

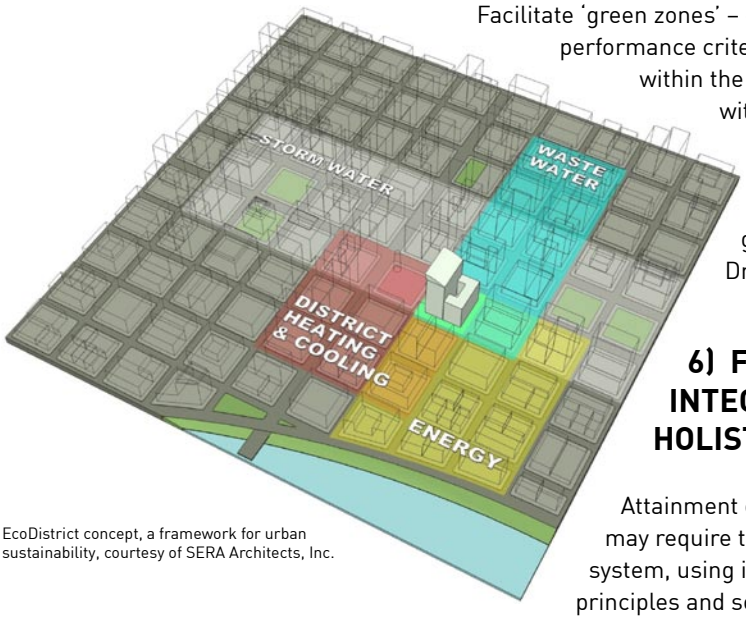
210 Sissine, Fred. "CRS Report for Congress: Renewable Energy R&D Funding History: A Comparison with Funding for Nuclear Energy, Fossil Energy, and Energy Efficiency R&D," April 9, 2008: http://fpc.state.gov/documents/organization/104708.pdf

211 The new U.S. Energy Independence and Security Act of 2007 included storage as a "Smart Grid" feature, and therefore eligible for grants: United States Bill H.R.6 Title XIII Smart Grids: http://thomas.loc.gov/cgi-bin/query/z?c110:H.R.6, cited in Peters, Roger (P Eng), and O'Malley, Lynda. *Storing Renewable Power*, The Pembina Institute, June 2008: http://pubs.pembina.org/reports/StoringRenewablePower-jun17.pdf

212 The Energy Storage Technology Advancement Act (2007) includes R&D funding support for storage technologies aimed at supporting the grid, totaling $50 million/fiscal years 2009 to 2014, plus $80 million for applied research. http://www.cbo.gov/ftpdocs/87xx/doc8728/hr3776.pdf, cited in Peters, Roger (P Eng), and O'Malley, Lynda. *Storing Renewable Power*, The Pembina Institute, June 2008: http://pubs.pembina.org/reports/StoringRenewablePower-jun17.pdf

213 The Energy Storage Technology Advancement Act also recommends institution of an Energy Storage Advisory Council.USA Legislation Briefing Information: Energy Storage Technology Advancement Act of 2007." Electricity Storage Association's (ESA) Annual Meeting in Anaheim, California, May 19-22 2008, in Peters et al, ibid.

5) CREATE GREEN ZONES AND DESIGNATED SUSTAINABLE DEVELOPMENT DISTRICTS WITH HIGHER INTEGRATED PERFORMANCE CRITERIA AND REGULATORY AUTHORITY.



EcoDistrict concept, a framework for urban sustainability, courtesy of SERA Architects, Inc.

Facilitate 'green zones' – development zones or districts with both higher performance criteria and consolidated regulatory authority, or an agency within the jurisdiction having authority with the ability to intercede with all other regulatory agencies on behalf of the integrated goals of the zone or project. Such zones could be based on the framework of the NYC Battery Park City Authority.[214] [215] A good framework for creating green zones is the Rock Mountain Land Use Institute's Draft Sustainable Community Development Code.[216]

6) FACILITATE THE CREATION OF AN INTEGRATED REGULATORY PROCESS AND A HOLISTIC, INTEGRATED REGULATORY SYSTEM

Attainment of national and regional sustainability goals ultimately may require the development of a holistic, integrated regulatory system, using integrated regulatory processes based on system principles and societal goals. It is recognized that approaching this ideal level of synthesis may be unattainable, however the existing regulatory and systemic barriers described previously are so significant, and result in such enormous direct,[217] indirect[218] (health and societal) and opportunity[219] costs as to make creation of this system look extremely attractive by comparison. Examples like the green zone enabled in New York City Battery Park City Authority, the City of Seattle's Department of Planning and Development consolidation, and the Rocky Mountain Land Use Institute Sustainable Community Development Code give reason to believe that this

214 Kneeland, Craig, New York State Energy Research & Development Authority. Personal communications with Sonja Persram, 2006. As well: Hugh L. Carey Battery Park City Authority Commercial/Institutional Environmental Guidelines 1.0, March 2002. NYC Battery Park City Authority is a model by which multi-level governments can leverage innovation, overcoming the problem of regulatory fragmentation and more favourable treatment of conventional methods by using a separate organization authorized to harmonize and intercede with regulatory bodies to this standard. In this model, a "green zone" for sustainable development was facilitated for a 92-acre residential and commercial neighborhood in Lower Manhattan. This public benefit corporation was created, in part to address the complexity of the regulatory approval process for projects and ensure that sustainability goals were retained. They act as an intermediary between projects and all regulatory agencies to support achievement of sustainability goals, facilitate changes in the regulatory system, and relieve developers of the costs of dealing with a complex regulatory environment. This has been a significant added incentive for developer participation.

215 Ed Clerico. Personal communication with Sonja Persram, April 2008: recommended 'green zones' like NYC Battery Park City Authority

216 (RMLUI)'s draft Sustainable Community Development Code identifies conflicts between sustainable community goals and standards, and the goals of conventional land use planning, zoning and building regulations.

217 Evan Mills, staff scientist at the Energy Analysis Department of the Lawrence Berkeley National Laboratory noted that an examination of post-Katrina economic losses on a per-capita basis shows regions utilizing building codes and extensive land-use planning experienced three-times lower losses. Mills added in an April 2008 personal communication with Sonja Persram that the insurance industry is mystified about why a) durability and b) disaster-resilience are not yet included in LEED rating systems. Citation: Burby, R.J. "Hurricane Katrina and the Paradoxes of Government Disaster Policy," Annals of the American Academy of Political and Social Science, March 2006, in Evan Mills, From Risk to Opportunity 2007: Insurer Responses to Climate Change, November 2007

218 "Health and productivity benefits that would be obtained from implementing and enforcing minimum standards of energy efficiency for commercial and residential buildings: $170 billion annually." American Council for an Energy Efficiency Economy, cited in U.S. DOE, EERE: http://apps1.eere.energy.gov/states/alternatives/codes_standards.cfm

219 Opportunity costs, as noted by key sources: "Adopting and enforcing minimum levels of energy efficiency for commercial and/or residential buildings may save society billions of dollars. It can also result in more durable and disaster-resistant construction. (Energy Codes and Standards,US DOE, EERE: http://www.eere.energy.gov/states/alternatives/codes_standards.cfm accessed June 18, 2008); and Global Markets for low-carbon energy products are likely to be worth at least $500 billion per year by 2050, and perhaps much more." From The Stern Review: http://www.hm-treasury.gov.uk/

kind of cooperation can be achieved with appropriate support and motivation. Recommendations include:

- Convening a national conference on Regulations, Sustainability and the Built Environment, including participation of the full spectrum of public interests in the built environment to begin a process of creating a holistic and comprehensive regulatory "system."
- Developing national policies and support for continuous representation in regulatory processes of human and ecosystem health, as well as explicit representation for the welfare and rights of future generations.[220]
- Developing a national policy to ensure explicit regulatory process inclusion of these public interests.
- Incorporating a formalized anticipatory and precautionary focus into regulatory processes.
- Adopt legal and regulatory systems that motivate and encourage positive outcomes (not merely prevention of negative ones).
- Encouraging insurance and reinsurance regulators to require executive leadership of any entity with significant climate and other environmental impacts, to be educated about climate change, energy and other risk exposure related to their environmental performance as well as sector-specific best practices and strategies.
- Encouraging regulators to require insurers, financial and investment advisors to recognize portfolio risks of unsustainable activity particularly with respect to climate change.
- Enabling a comprehensive public process to articulate societal goals, assess the overall regulatory needs and relationships to support those goals, and then design a coherent regulatory system based on clearly articulated and agreed upon principles.
- Adopt legal and regulatory systems that recognize and account for cumulative environmental impacts and the limits of ecological systems.
- Develop a system for recognizing enhanced value of projects voluntarily internalizing as many of these risks and impacts as possible.

7) ENSURE SOCIAL EQUITY IN POLICIES THAT SAFEGUARD PUBLIC HEALTH, SAFETY, AND WELFARE

Social equity represents the next generation of concern beyond economics and environment that is nevertheless completely interconnected with these triple-bottom-line factors. The built environment has a sphere of influence on individuals, communities and broader society that can add to or detract from human health and well being – and which consequently can have enormous economic and environmental impacts. Attending to built environment social equity issues involves identifying as many of the positive and negative factors as possible which affect humanity within this sphere – and acting to enhance or remove them, respectively. Regulations in the built environment and related sectors play a significant role, as discussed extensively throughout this report.

220 Private interests typically pay professionals to "volunteer" for these committees, and also have both the financial resources and incentive to participate fully in every meeting. Many who represent the public interest often do so at their own expense and commitment of time. A related issue is the lack of financial support for representation in regulatory processes for non-commodified materials, systems or designs that while environmentally preferable, are either in the public domain, such as adobe, rammed earth, or straw bale construction, or are not product based, such as passive design strategies, or greywater or water harvesting systems that can be constructed using standard off the shelf components. Without balanced recognition of the full risk profile of competing alternatives, those without financial backing are likely to lose out regardless of their actual performance or benefits: http://files.eesi.org/Eisenberg_062008.pdf and http://www.eesi.org/062008_Straw-Bale_Construction

The U.S. Green Building Council has made social equity a priority in their strategic planning and is working to expand it throughout their operations. A Living Building impacts people working on the building, as well as people working in and around it and this is recognized in the Living Building Challenge prerequisites.

In light of the current environmental and economic crises, and the vital role that green buildings have in the opportunity to address these challenges, it is of growing importance to ensure that everyone can participate in their benefits and that the regulatory realms enable this participation. For example, the Apollo Alliance[221] represents an opportunity for all citizens to be engaged in greening buildings. As well, native communities, among the poorest in both countries, have substantial housing, energy and water needs – as well as tremendous opportunities to use renewable resources such as waste straw for buildings, for local economic development and for jobs based on tribal renewable energy utilities and energy efficiency programs.[222] [223]

CONCLUSION

It is important to re-examine the definition of safety and the goal of safeguarding the public from hazards attributed to the built environment: the basis for most codes. Decisions are currently made based on perceptions about what is needed to protect people in specific buildings. The deeper questions about who is protected from what, in what time frame and where, and at what ultimate cost are rarely asked. The result is a regulatory realm with narrowly focused concerns and enormously broad impacts, a realm that intends to protect us in each instance, but in the end places society, the environment and the economy in jeopardy by ignoring, and thus encouraging the destruction of, the natural systems on which we all depend for our survival. In the end what is left is a moral issue requiring the re-examination of the ends desired and the means required to achieve them. If people believe they have a right to be safe and healthy, that their descendants share that same right, and that there is a commons – the shared inheritance of a commonwealth of resources including a healthy atmosphere; clean water; productive, healthy and resilient ecosystems; and a natural resource base that can sustain itself – then people must also accept that there must be a balance between individual and community rights. And if that is the case, efforts to regulate the built environment must be similarly balanced. The clear signal of change will be when it is more difficult to gain regulatory approval for practices contributing to these critical problems than for projects such as pursing the goals of the Living Building Challenge that contribute to their solution.

221 http://www.apolloalliance.org/

222 U.S. DOE, Energy Efficiency and Renewable Energy Tribal Energy Program: http://apps1.eere.energy.gov/tribalenergy/

223 Intertribal Council on Utility Policy: http://www.intertribalcoup.org/mission/index.html

MODULE 5

ACKNOWLEDGMENTS
RESOURCES
REFERENCES

The deeper questions about who is protected from what, in what time frame and where, and at what ultimate cost are rarely asked.

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AIA and MRAIC denote American and Canadian architects respectively
PE and P.Eng. denote American and Canadian engineers respectively

RESOURCES

Cutting the Green Tape: An Action Plan for Removing Regulatory Barriers to Green Innovations.
West Coast Environmental Law. April 2002. www.wcel.org/wcelpub/2002/13724.pdf

This report, published by West Coast Environmental Law out of Vancouver, BC, evaluates the myriad of existing regulatory barriers to innovative green building and development practices. Cutting the Green Tape provides an overview of green development practices including detailed research on land use and building code barriers in British Columbia. Highlighting examples from both BC and the United States, the report cites specific action steps for moving local governments towards support of sustainable practices, prioritizing those that have the greatest opportunity for impact.

The action plan recommends the following steps:

- Creation of a "Smart Bylaws Guidebook" to address reform in zoning bylaws with the goal of encouraging compact communities and protection of natural amenities.
- Review of regional growth strategies to encourage increased density and mix-use development.
- Examination of development requirements for parking to reduce automobile use.
- Assessment of development cost charges to reflect financial impacts for reduced demand on municipal infrastructure related to green development practices.
- Empowerment of local government in removing barriers by allowing for regulation flexibility within the Province.
- Education of building officials by highlighting successes from demonstration projects.

- Examination of risk and liability placed on local governments by new and innovative green development practices, and ways to underwrite and insure against these risk.
- Changes to the review process to allow for a more "integrate permitting process".
- Address barriers related to fire and safety that compromise environmental performance.
- Address specific building, plumbing and energy codes that discourage green building
- Address health barriers to onsite wastewater treatment and water reuse.
- Development of new standards for greenfield sites.

Good Health Counts: A 21st Century Approach to Health and Community for California.
Prevention Institute. November 2007. www.preventioninstitute.org.

This report, prepared by the Prevention Institute, outlines the cost of poor health in our communities. While the increasing cost of healthcare coverage has major impacts on businesses and families, this report highlights the creation of new community health "infrastructure" that includes the involvement of a wide variety of disciplines and organizations such as architects, city planners, transportation engineers, insurers, employers, the home loan and banking sectors, housing, public safety, public works, and private businesses. The report describes the relationship between the environment and its effect on humans, providing recommendations and methods for evaluating opportunities for creating better community health.

Green Building in North America. Background Paper 3b—Institutional Efforts for Green Building: Institutional Efforts for Green Building in Canada and the United States.
Alex Wilson, Jennifer Atlee and Douglas Webber. March 2008. www.cec.org.

This report discusses a variety of institutional approaches to advance green building practices in Canada, Mexico and the United States. The report highlights five key barriers that exist for rapid market transformation of building green: inertia, lack of credible data, market dysfunctions, short-termism and silos or historical divisions and territoriality that inhibits change. The authors include recommendations for addressing barriers at all levels, from simple improvements to existing systems to more far-reaching, economy-wide shifts.

Green Building in North America. Background Paper 2b: Toward Sustainable Financing and Strong Markets for Green Building: US Green Building Finance Review.
Leanne Tobias. March 2008. www.cec.org.

This report, prepared as part of a larger research effort being undertaken by the Commission for Environmental Cooperation to accelerate green building in North America, provides research on the real estate finance market for green buildings in meeting the 2030 Challenge. The report provides an overview of the governmental, institutionally-owned, private commercial and residential, and affordable housing markets and describes existing financial incentives and green financing options. The report provides recommendations that include increased collaboration of private industry, federal and local governments and non-profit organizations to create financial incentives for green buildings. Additionally, the author recommends that energy savings be identified by all sectors as a source of cash flow for the repayment of energy-efficient building construction and renovation projects.

Greening the Tax Code. Craig Hanson and David Sandalow.
The Brookings Institute and World Resources Institute. April 2006. www.brookings.edu/papers/2006/04environment_hanson.aspx.

This policy brief examines possible taxes on air and water pollution that could generate substantial revenue for the federal government while improving environmental quality, stimulating technological innovation and enhancing energy security. The report analyzes three different types of pollution taxes—water pollution tax, nitrogen fertilizer tax, and a carbon tax—as a way to shift the tax burden onto activities that make the economy unproductive or reduce quality of life.

Greywater Recycling. BC Green Building Code Background Research.
Light House Sustainable Building Centre. October 2007. www.sustainablebuildingcentre.com.

This White Paper provides technical research on graywater recycling intended to provide a resource for the province in the development of green building regulations. The paper provides a comprehensive overview of greywater recycling including benefits of reuse, known risks and mitigation efforts, and various technologies for collection, treatment, and storage of greywater. The paper highlights policies and regulations that have been adopted in other provinces, states and countries, and identifies barriers to greywater recycling in current BC acts and regulations.

Materials Emissions & Indoor Air Quality.
BC Green Building Code Background Research. Light House Sustainable Building Centre. October 2007. www.sustainablebuildingcentre.com.

This White Paper provides an overview of the major known indoor air pollutants, the associated health concerns, and the costs associated with poor indoor airy quality. The paper assesses varying testing, rating and labeling systems currently in use and finds that the data necessary for establishing clear scientific standards is often lacking. The paper lists common building materials and their associated pollutant impacts, as well as post-construction pollutant sources such as furnishings, cleaning agents and occupant practices. The paper concludes that there is a need for more economic analysis on the impacts of poor indoor environments, and on the costs and benefits of potential regulatory approaches.

Municipal Green Building Policies: Strategies for Transforming Building Practices in the Private Sector.
Environmental Law Institute. April 2008. www.elistore.org.

This new report reviews policies from over 25 different municipal governments that promote green building in the private sector. The report lists different policy options including those that mandate green building practices, those that provide expedited review of green building projects, and those that provide other direct financial incentives. Other governmental incentives and services, such as technical assistance and promotional materials, are also discussed. The report provides valuable information about these policies and their implementation, drawing on actual experiences of local municipalities, providing policy makers with valuable research and examples. The report does not rate or rank current policies, nor does it evaluate the results of the policies. Instead it provides objective research to help provide a better understanding of the various approaches to addressing green building in the private section.

New York Energy $martSM Program Evaluation and Status Report.
March 2008. www.nyserda.org/pdfs/Combined%20Report.pdf.

This report evaluates the 2007 results from the New York Energy $martSM public benefits program. The program develops competitive markets for energy efficiency; provides outreach and education services to New York residents; and supports research and demonstration of the economic and environmental benefits to increased energy efficiency, particularly to low-income communities. By year-end 2007, the program's efforts achieved 3,060 GWh of cumulative annual electricity savings, and 4.6 million MMBtu of natural gas, fuel oil and other fuel savings.

Sustainable Community Development Code: A Code for the 21st Century. Beta Version 1.1.
Rocky Mountain Land Use Institute. http://www.law.du.edu/index.php/rmlui/sustainable-community-development-code.

This publication provides a framework for identifying and analyzing obstacles and incentives to land use codes that support sustainable community development. The Beta Version 1.1 is a work in progress expected to be amended over time. It includes recommendations to remove obstacles, create incentives, and enact standards in the following topic areas: climate change and greenhouse gas reduction, community health and safety, food production and security, housing affordability

and diversity, protection from natural hazards, renewable energy systems, and water conservation. For each topic, the publication establishes a set of goals and outlines a range of good/better/best recommendations, citing example code and programs from around the country.

Sustainable Design Guidelines Reference Manual for World Trade Center Redevelopment Projects.
Port Authority of New York and New Jersey (PANYNJ), the Lower Manhattan Development Corporation (LMDC) and New York State Energy Research Development Authority (NYSERDA). March 2005. www.renewnyc.com/plan_des_dev/design_guidelines_manual.asp.

This publication provides a series of guidelines intended to address sustainability goals for the redevelopment of the World Trade Center site. Using the US Green Building Council's LEED Rating System as a reference standard, this publication provides implementation strategies that highlight whole systems design and support community connectivity goals.

Toxic Nation: A Report on Pollution in Canadians. Environmental Defense.
November 2005. www.environmentaldefence.ca.

The first Canadian study to test for a broad range of chemicals found in individuals across the country, this report summarizes the study's findings that no matter where people lived, how old they are or what they do for a living, measurable levels of chemicals were detected. The purpose of the study was to determine what chemicals existed and to create awareness of strategies people can take to reduce their exposure to such chemicals. Environmental Defense tested 11 people from across the country. On average, 44 chemicals were detected in each volunteer, including 41 carcinogens, 27 hormone disrupters, 21 respiratory toxins and 53 reproductive/developmental toxins.

Water Efficiency. BC Green Building Code Background Research.
Light House Sustainable Building Centre. October 2007. www.sustainablebuildingcentre.com.

This White Paper provides an overview of the importance of water conservation and reviews existing policies and regulations around water conservation and reuse in Canada, the United States, and countries. The paper highlights the direct economic benefits of water efficiency measures in examples from the cities of Barrie, Ontario, and Cochrane, Alberta. The paper also recognizes barriers to water efficient plumbing practices such as changing technologies and performance of pioneering systems. Water metering that allows for consumption-based pricing is identified as a critical strategy for reducing water use. The paper recommends options for water conservation amendments to the Building Code including increased water efficiency performance standards and a prescriptive path that could require specific fixtures based on consumption targets or flow rates. Other options include economic and financial tools, such as grants and rebates, loans, taxation programs, pricing structures, and fines; and educational programs, including rating and labeling systems, awards and recognition programs.

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Open source building materials evaluation tool that employs life cycle thinking and provides criteria on health & pollution, environment & resources, and social & community impacts.

Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)
www.epa.gov/nrmrl/std/sab/traci/
An evaluation tool using weightings including: ozone depletion, global warming, acidification, cancer, noncancer, eutrophication, smog formation, ecotoxicity, fossil fuel use, land use, and water use.

Athena Institute | www.athenasmi.org

Cradle to Cradle | www.mbdc.com/c2c

U.S. Environmental Protection Agency | www.epa.gov
The EPA website provides general regulation information as well as specifics on laws governing human health and environmental hazards related to building materials.

General Laws, Regulations, Guidance and Dockets | www.epa.gov/lawsregs/index.html

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www.osha.gov/comp-links.html

Green Guide for Health Care | www.gghc.org

The Healthy Building Network | www.healthybuilding.net

Society of Environmental Toxicology and Chemistry (SETAC) | www.setac.org

Building Ecology | www.buildingecology.com/index.php

University of Bath Biomimetics & Natural Technologies
www.bath.ac.uk/mech-eng//biomimetics/index.html

Biomimicry Institute | www.biomimicryinstitute.org

The Biomimetics Network for Industrial Sustainability | www.extra.rdg.ac.uk/eng/BIONIS/

C2C | www.cradletocradlehome.com/wst_page2.html

Science & Environmental Health Network | http://www.sehn.org/

Green Science Policy Institute | http://www.greensciencepolicy.org/

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www.bdcnetwork.com/contents/pdfs/BDCWhitePaperR2.pdf

City of Toronto Solid Waste Management Services. 2005 Business Plan. www.toronto.ca/garbage/pdf/2005_plan.pdf

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